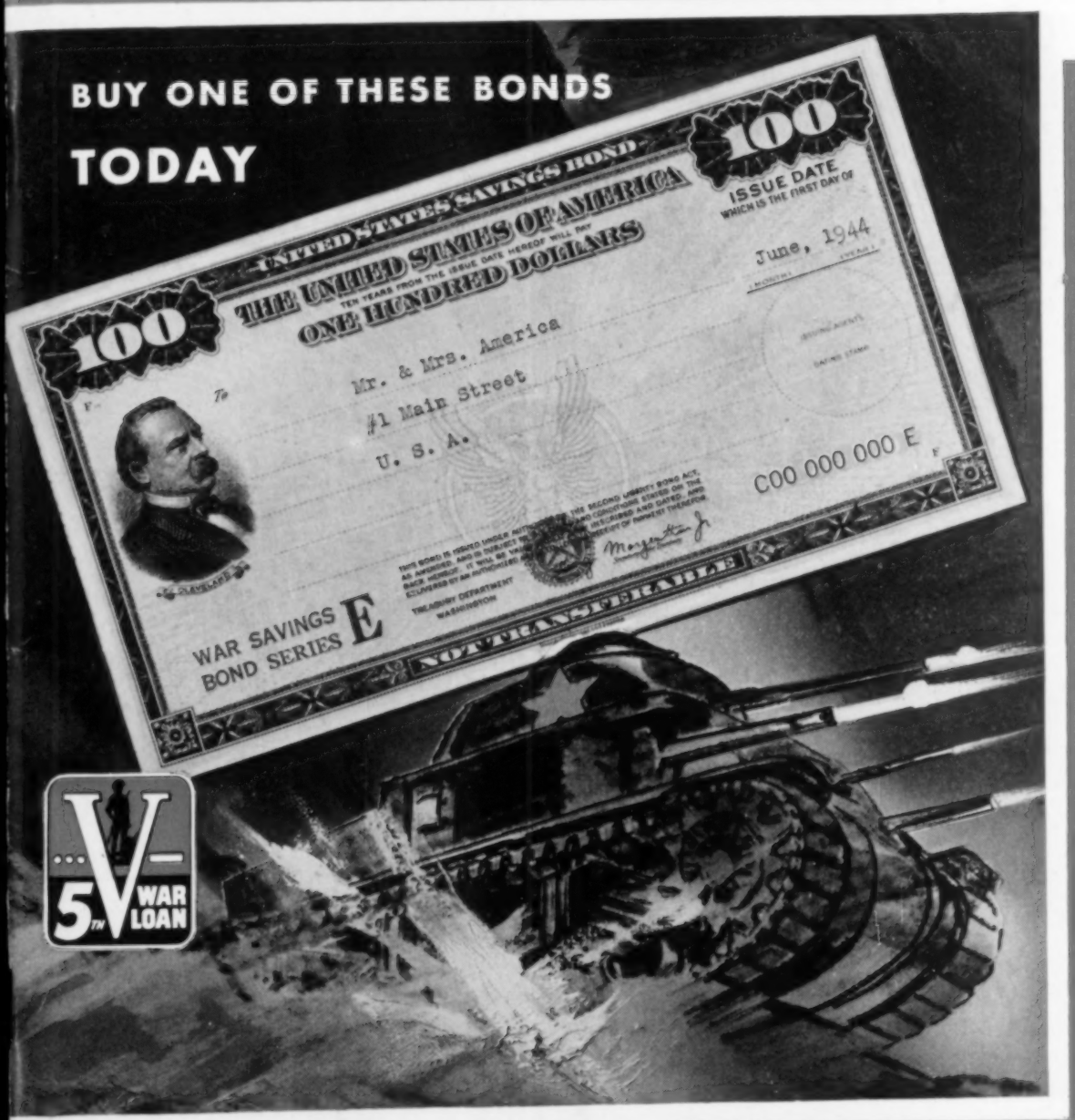
Compressed Air Magazine

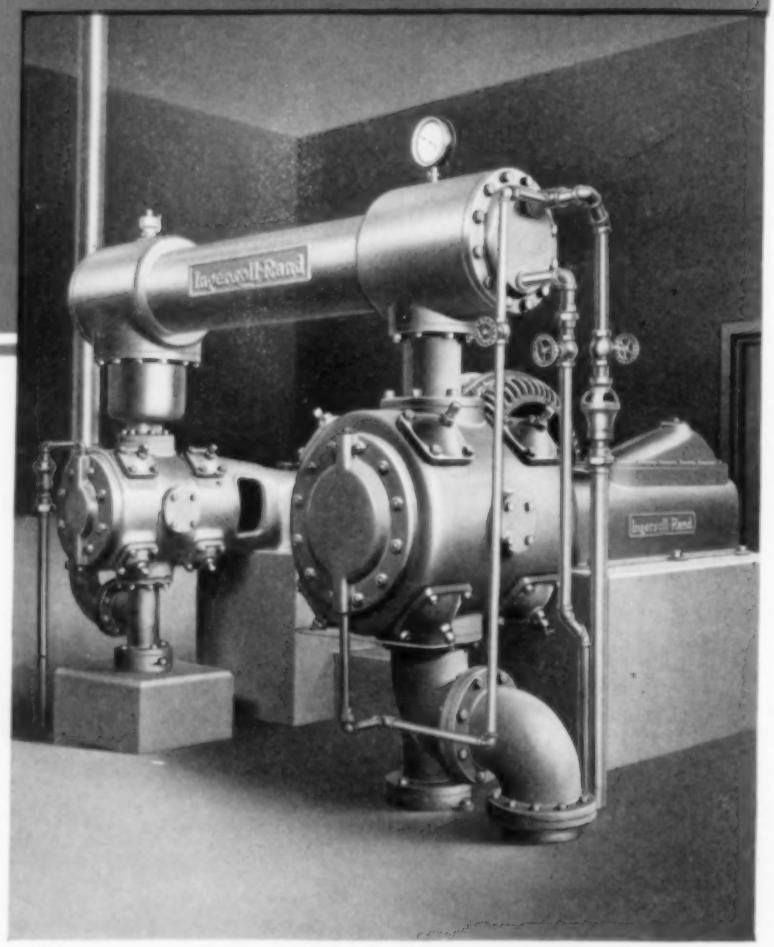
JUNE 1944



VOLUME 49 • NUMBER 6 NEW YORK • LONDON

★ ★ ★ ★ ★ **HERE'S THE WAY TO GET**

Oil-free COMPRESSED AIR



• If *your use* of compressed air is such that all traces of oil must be eliminated from the air, then you need Ingersoll-Rand compressors fitted with Type N-L (non-lubricated) cylinders. These machines run without oil, glycerine, water or any other lubricant in the air cylinders... because they have special pistons fitted with graphitic-carbon wearing rings and piston rings.

Let one of our field engineers tell you how Type N-L compressor cylinders are solving the air problem in food and process industries, and in instrument-control systems which require oil-free air. Compressors fitted with N-L cylinders range from 5 to 300 horsepower...for pressures up to 125 lb per sq inch...all built for heavy-duty service.

NOTE: Remember that when properly operated and cared for, and when equipped with an aftercooler, standard I-R heavy-duty compressors with oil lubrication can deliver air that contains only small traces of oil. In most applications of compressed air, a small amount of oil is a help rather than a detriment. However, if your compressed air must be absolutely free of oil, the Type N-L compressors described above should be selected.

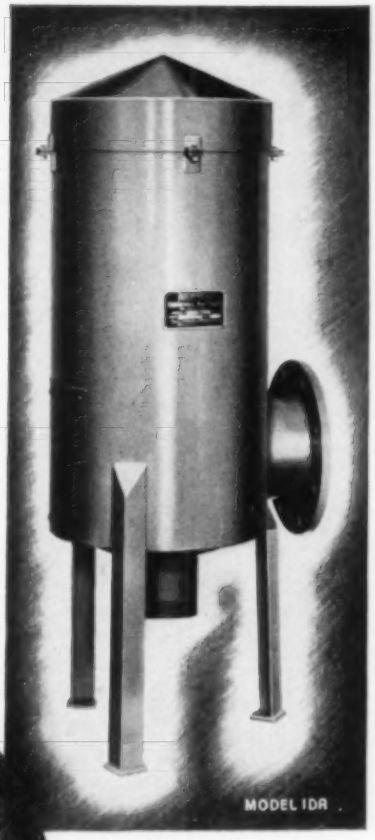
Ingersoll-Rand

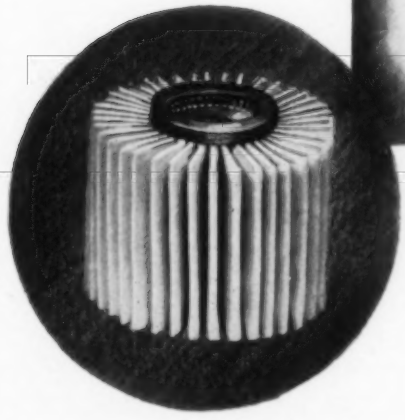
11 Broadway, New York 4, N. Y.

1-455

COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS • CENTRIFUGAL PUMPS • CONDENSERS • OIL AND GAS ENGINES

new STAYNEW Intake Air Filter





EXCLUSIVE RADIAL FIN CONSTRUCTION PROVIDES:

- *More Filtering Area
- *Greater Efficiency
- *Less Resistance
- *Less Frequent Servicing

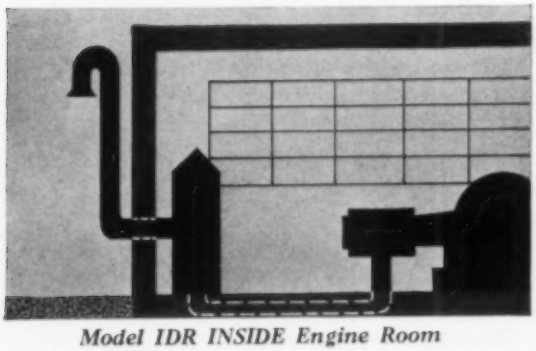
ALL THE CONVENIENCE OF GROUND LEVEL INSTALLATION

ALL THE EFFICIENCY OF HIGH LEVEL AIR INTAKE

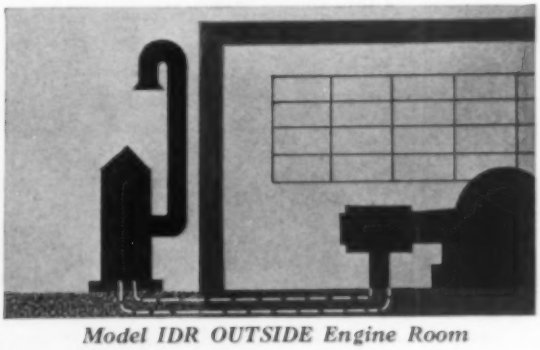
NOW you can equip compressors and internal combustion engines with a Staynew filter providing all the recognized advantages of the famous Protectomotor line . . . *plus* an exclusive combination of two new features.

The new filter, Staynew Model IDR, or IDRS (Silencer), is so constructed that *installation and servicing can be effected at ground level* (right in the engine room itself if preferred), and the *actual air intake located at the most suitable point.*

Models available with solid base for installation when compressor or engine intake is below floor level.



Model IDR INSIDE Engine Room



Model IDR OUTSIDE Engine Room

Engineering Data on request STAYNEW PROTECTOMOTOR FILTERS Representatives in Principal Cities

DOLLINGER CORPORATION

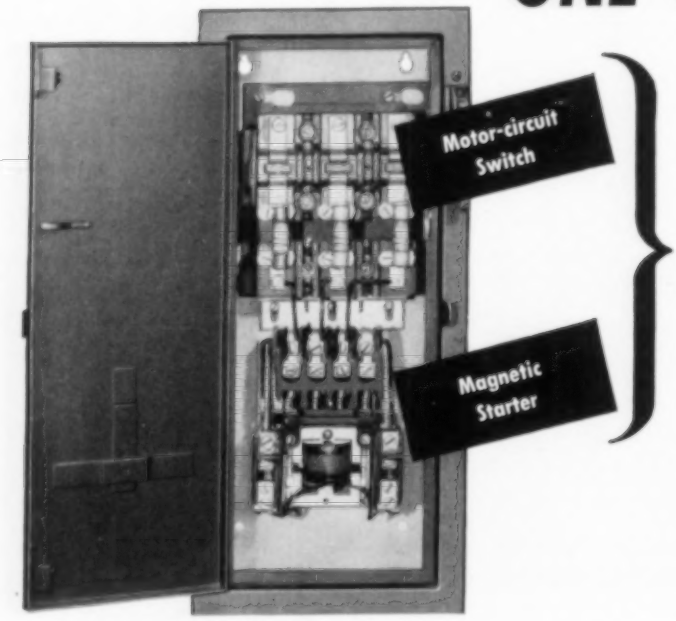
(Formerly Staynew Filter Corporation)

7 Centre Pk.

Rochester 4, N. Y.

EVERYTHING YOU NEED

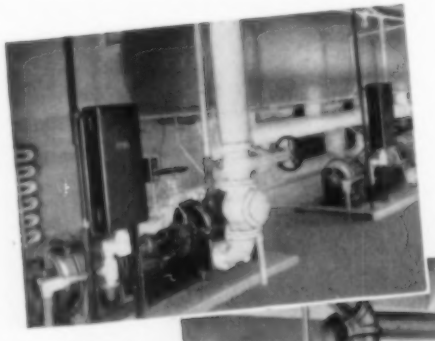
to control and protect your motor in ONE COMPACT UNIT



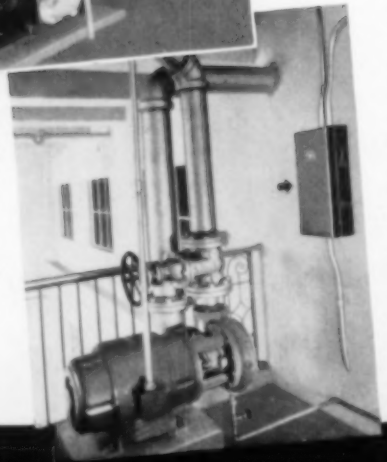
COMBINATION STARTER

Complete full-voltage control of squirrel-cage motors or the primary control of wound-rotor motors—with extra safety, very low installation cost, good appearance, and other advantages

Why two devices? ONE can do the job.



G-E combination starters can be mounted on or near the machine, even in damp locations, such as shown in this pump-room installation



This combination starter drives a ball-bearing splash-proof motor direct-connected to a centrifugal pump

Which Type Do You Need?

If you want short-circuit protection, you can select a starter which has a fusible motor-circuit switch or a breaker to provide such protection. Or, if you do not need short-circuit protection, you can choose a starter which is equipped with a nonfusible motor-circuit switch that serves only as a disconnect and provides no short-circuit protection. Both types are available in a variety of enclosing cases.

Co-ordinated for Protection

With G-E combination starters, you're sure that the motor-circuit switch or breaker has the proper rating for the magnetic starter with which it is used. The fuses or breakers provide adequate short-circuit protection to the motor, the starter, and subsequent motor-branch-circuit conductors when connected to a power supply for which they are recommended. The co-ordination of thermal overload relays with the fuses or breakers affords complete motor overcurrent protection under any condition of operation.

Increased Safety

The motor-circuit switch, being in the same case with the magnetic starter, is mechanically interlocked with the cover. Thus the cover cannot be opened while there is power on the starter. This is an important advantage because, when a separately mounted switch and starter are used, there is nothing to prevent the operator from opening the starter case while the starter is "hot."

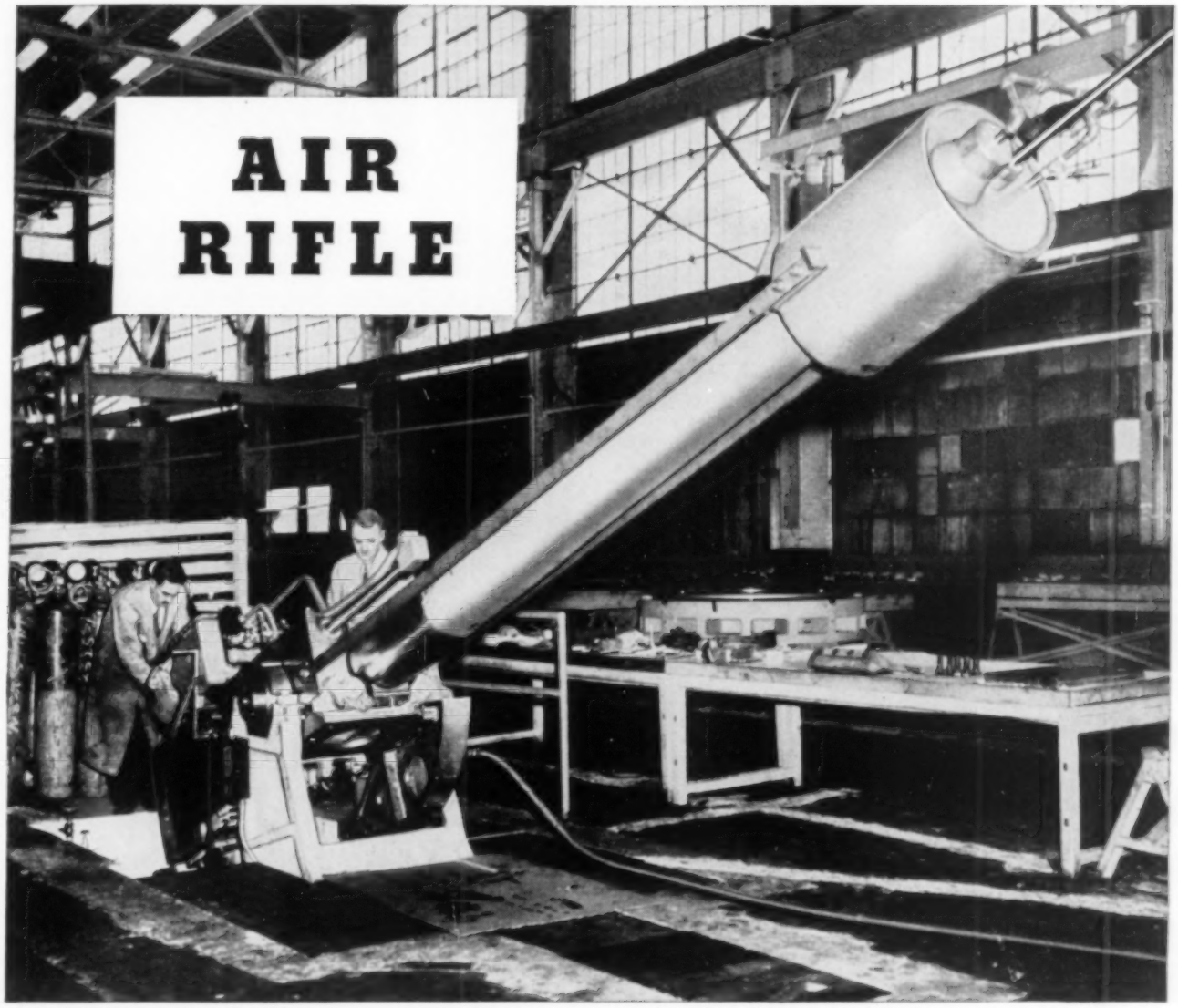
WANT MORE DATA?

More complete information on combination starters will be found in Bulletin GEA-3715. Ask our nearest office for this bulletin or write direct to General Electric Co., Schenectady 5, N. Y.

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

GENERAL ELECTRIC

676-130B



STAND BY . . . load . . . fire on the buzzer! But the "gunpowder" is compressed air, the firing range the factory floor. It's a new method used by Fisher Body engineers for testing kick, rammer and firing of 5" naval guns.

Producing large quantities of compressed air to pinch hit for naval shells or to operate air tools in the nation's mines and factories requires efficient compressor performance. This is assured with Texaco lubrication.

Texaco Alcaid, Algol or *Ursa Oils* assure wide-opening, tight-closing valves, free piston rings, open ports, clear lines. Their use in air compressors is nation-wide. They assure maximum service life between overhauls, fewer repairs and replacements.

Texaco lubricants have proved so effective in service that they are definitely preferred in many fields, a few of which are listed at the right.

Texaco Lubrication Engineering Service is available to you through more than 2300 Texaco distributing points in the 48 States. The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

TEXACO

TEXACO Lubricants

FOR ALL AIR-COMPRESSORS AND TOOLS

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

RockerShovel "Ro

1.

2.

"Shoot the Round"—in drift, cross-cut, haulage-way, stope or raise—and load the ore or rock faster and cheaper with an Eimco RockerShovel than by any other method.

The RockerShovel is simple in design and easy to operate but rugged as a battleship. Armored against the roughest kind of usage its sturdy construction assures low up-keep costs—maintenance records over long periods verify this.

Yes! For trouble-free, dependable service—"Roundup" the muck with an Eimco RockerShovel.

Eimco RockerShovel

EIMCO

THE EIMCO CORPORATION, Salt Lake City 8, Utah
New York 5: 67 Wall Street Sacramento 14: 1217 - 7th Street
Chicago 2: 111 W. Washington St. El Paso, Mills Building

oundup"

3.

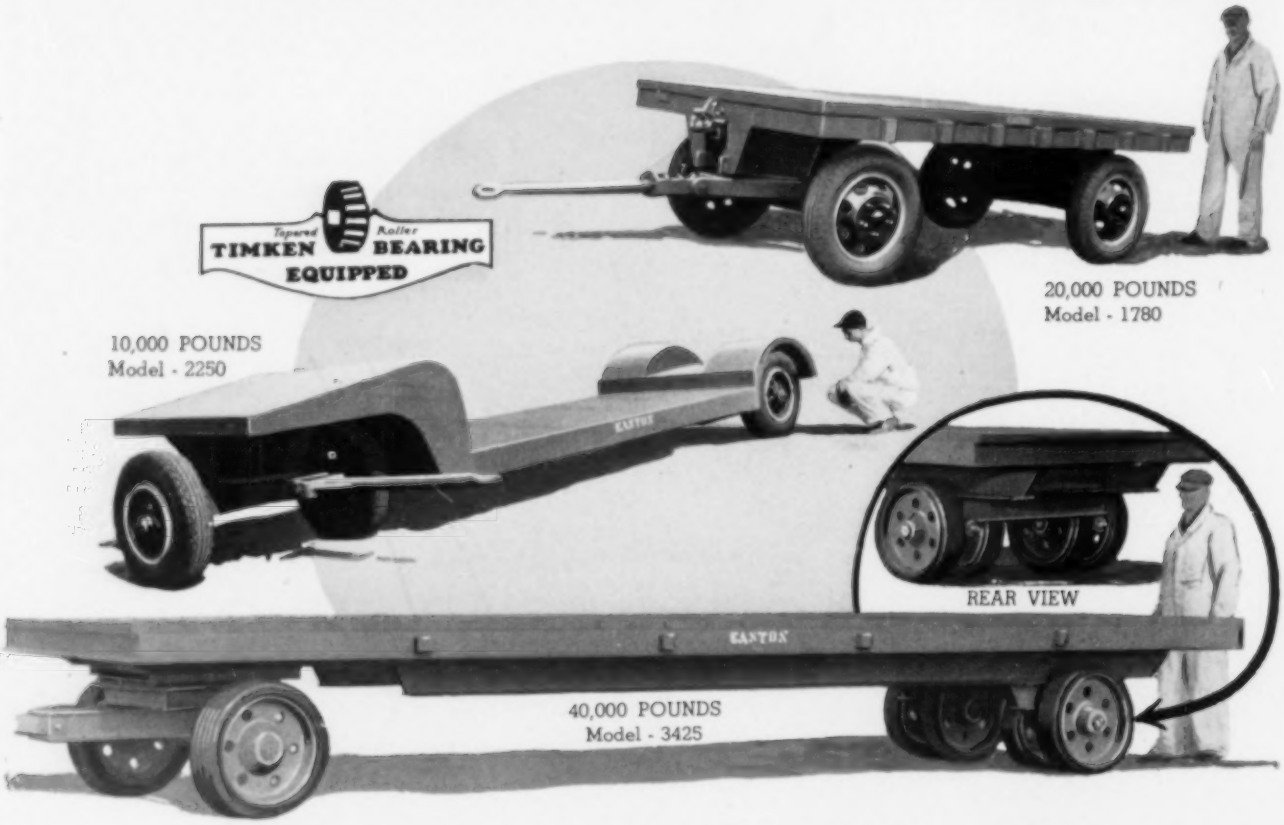
4.

5.

1. Narrow drifts are easily mucked by Model 12-B Rocker-Shovel.
2. Eimco Model 12-B in cross cut loads cars full without spillage.
3. Raise round shot down on drift quickly mucked out by Eimco 12-B.
4. Eimco RockerShovel shown mucking out large open stope is Model 12-B.
5. Large haulageways are mucked clear by the Eimco Model 21 RockerShovel.

A 57

EASTON
• • INDUSTRIAL TRAILERS



for extra heavy-duty *Service*

The transportation of heavy materials within the plant often presents a real problem to war industries. By developing heavy-duty, rubber-tired trailers for the really tough jobs, EASTON has made a major contribution to the war effort. EASTON makes a specialty of engineering these high-capacity industrial trailers for the systematic handling of heavy materials that just can't be transported by conventional methods.

EASTON makes no attempt to build all types of trailers. Instead, time and attention are given solely to those projects where extra-heavy duty is involved. Shipyards, steel mills, shell plants, and other war industries use EASTON trailers to keep heavy materials on the move.

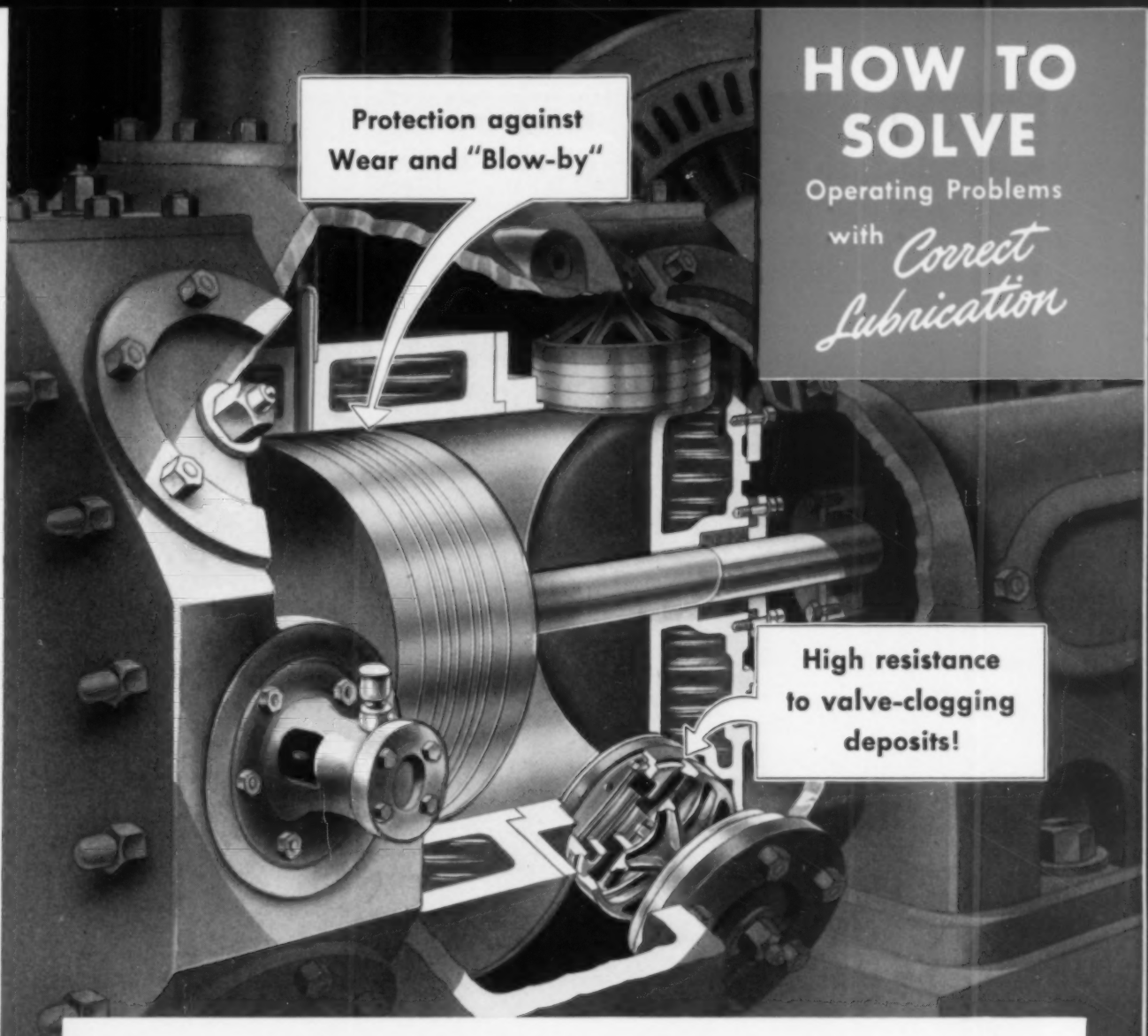
Many of these husky trailers have been in use since the early months of the war. They will still be going strong many months from now!

The limit in size or capacity of industrial trailers has not yet been reached . . . but EASTON is keeping step with this trend. Let EASTON figure on your requirements.

A-1004

EASTON CAR & CONSTRUCTION COMPANY · EASTON, PA

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION



HOW TO SOLVE

Operating Problems with *Correct Lubrication*

Get all this with Minimum Oil Feeds:

IN air compressor lubrication, the important factor is to get the *most* with the *least*—maximum protection with minimum feeds.

The oil you select must form strong films to protect pistons, rings and cylinder walls from wear and provide an effective seal against "blow-by."

This oil also must possess high chemical stability to resist the oxidizing influence of the high-temperature discharge air and the formation of valve-clogging deposits.

On the basis of proved performance, in compressors of all types and sizes, Gargoyle D.T.E. Oils provide the answers to these exacting compressor requirements. Their strong films assure minimum wear and low friction loss, and their resistance to oxidation assures minimum deposits.

All this with minimum feeds for clean, efficient operation and minimum accumulation of oil in the compressor system.

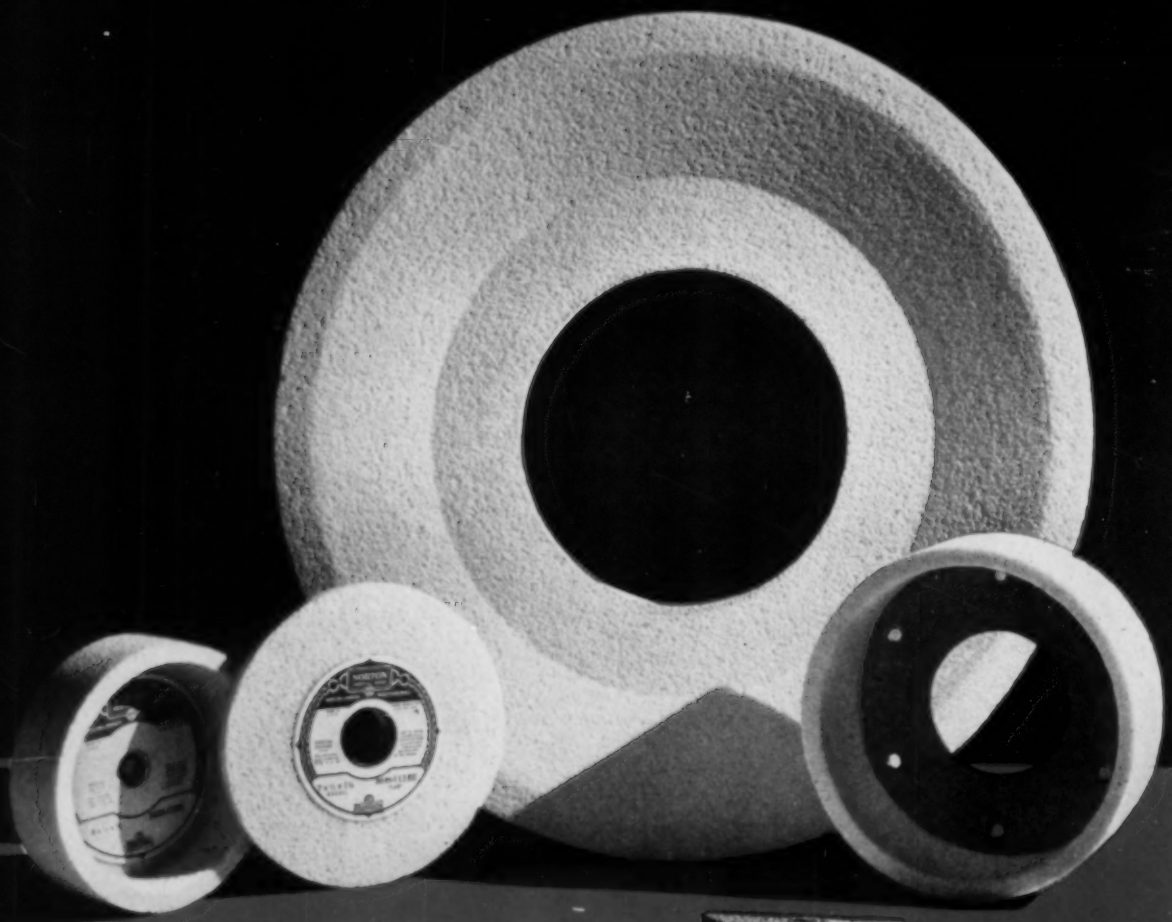
GARGOYLE
Lubricants

SOCONY-VACUUM OIL CO., INC., Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Magnolia Petroleum Company • General Petroleum Corporation of California.

CALL IN SOCONY-VACUUM

NORTON OPEN STRUCTURE GRINDING WHEELS

. . . Up to 24" Diameter Now



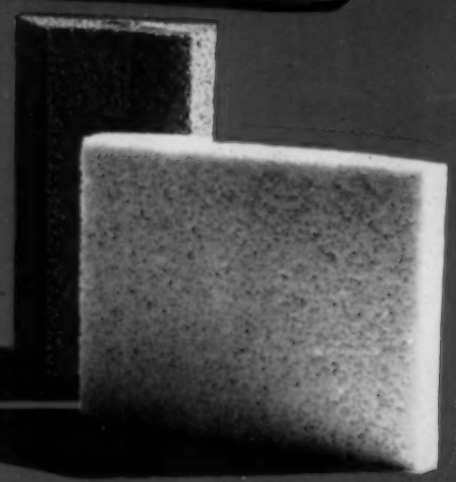
Industry now need not be handicapped by size limitations on grinding jobs that require open structure wheels—where the contact is broad—where the stock removal is especially heavy —where extra coolness of cut is essential.

Norton Open Structure Wheels are being supplied as large as 24" diameter by 4" wide and 20" diameter by 6" wide—and, of course, in all the usual tool room and surface grinding sizes and shapes, including segments.

Norton Open Structure Grinding Wheels and segments are ***uniform***—the same grinding action every time—a result of the Norton Controlled Structure process of manufacture.

NORTON COMPANY, Worcester 6, Mass.

Behr-Manning, Troy, N. Y., is a Norton Division



NORTON ABRASIVES

ON THE COVER

WE ARE one of more than 1000 periodicals that are helping the Treasury Department this month to publicize the Fifth War Loan Drive. Official Washington statements declare that "bonds are the best advertised product in history, but it hasn't cost the Government a cent." More than $240,000,000 worth of space, time, and manpower have been contributed by publications and private business, and more than 5,000,000 volunteer salesmen have served without pay during bond drives. As a result it has cost Uncle Sam only one cent for every $33 worth of bonds sold.

The Fifth War Loan Drive starts on June 12 and ends on July 8. The goal is $16,000,000,000, of which $6,000,000,000 is sought from individuals. More than 55,000,000 Americans now own at least one War Bond. We suggest that you read and heed our cover appeal: "Buy One of These Bonds Today."

•

IN THIS ISSUE

UNTIL the year 1879 cannons were predominantly muzzle-loaders. At that time England appointed an ordnance committee to consider the relative merits of muzzle-loading and breech-loading guns. The group committed the government to an experimental course in the construction of breech-loaders of some of the heaviest calibers then in existence. That was the beginning of the "built-up" cannon, which the British started to make in 1880. At about the same time Krupp in Germany turned out weapons of similar construction. The United States followed these foreign ordnance trends, beginning in 1882, and four years later officially established the Naval Gun Factory in Washington, D. C. Developments made since then are traced in our leading article.

•

A GENERATION ago the pharmacist's mortar and pestle were the symbols of pharmaceutical manufacture. Nowadays, a large proportion even of our prescription medicines is compounded in factories, and we buy them off the shelf. An article starting on page 146 gives some facts regarding one of the firms that makes some of these preparations.

•

TWO short articles—*New Bridges Unite the Americas* and *Killer of the Mesa*, two pages of pictures showing varied services performed by compressed air, and an article on the subaqueous use of pneumatic tools that supplements material in our May issue, round out the editorial contents.

•

AN EXPLANATION

IN A BRIEF article on seismic prospecting near power lines in our March issue the statement was made on page 81 that "it is reported that Primacord, which was developed by Robert L. Klotz, Jr., of the Hercules Powder Company, has greatly reduced the danger associated with this type of work." Mr. Klotz should have been credited only with the particular application of Primacord. The Ensign-Bickford Company developed Primacord and manufactures it.

Compressed Air Magazine

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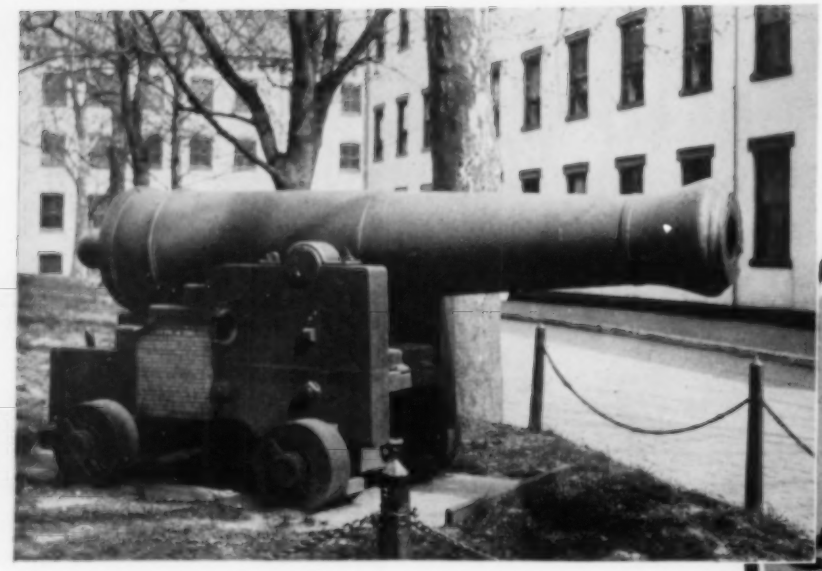


Official U. S. Navy Photos

Building Our Naval Guns

Robert G. Skerrett

THE Navy's battering gunfire is doing its full share in opening the way for an ultimate victory over our enemy in the Pacific. The performances of all types of our sea-borne guns in that theater emphasize how highly developed these weapons are and indicate something of the engineering skill and fine craftsmanship that have gone into their production. Where, may be asked, are these rifles manufactured? And the answer is, normally at the Naval Gun Factory in the Navy Yard, Washington, D.C., where it was officially established in 1886 so that the Bureau of Ordnance of the Navy Department could be in close touch with the important work in progress there.

The Washington Navy Yard was located in 1800 on the eastern branch of the Potomac River where the then newly created Navy Department purchased for $4000 thirty-seven acres of property about half of which was marshland and water. Even so, the station, as a general-purpose navy yard, was so far developed and equipped by 1812 that the *U.S.S. Constitution* was sent there for overhauling. During succeeding decades its ordnance department attained importance. However, it was not destined to become outstanding until we were aroused from the naval lethargy that hampered our progress after the Civil War. Even up to 1880 most of the guns for our combat ships were cast at outside establishments and, with some exceptions, the department centered its attention on research and experimental work. Then Congress and the Nation at large suddenly awakened to our weakness on the sea; and, after the usual legislative hesitation, funds were appropriated in 1882 for the building of four steel ships—three cruisers and a dispatch boat—that were to form the nucleus of our "New Navy." Among the difficulties with which we were thus abruptly confronted was that of obtaining suitable guns for those vessels—weapons that were to be radically different from those then in the service.

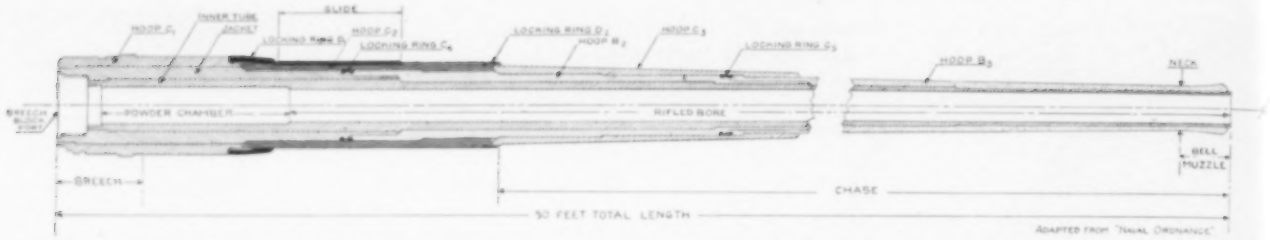
Most of the Navy's guns at that time were muzzle-loading, smooth-bore pieces, and the few that were breech-loading and rifled were converted from older types and recognized as experimental. However, they taught our ordnance experts valuable lessons. Something fundamental had to be done to meet the situation. The Secretary of the Navy, in his annual report for 1882, expressed himself in this fashion: "The principal purpose of our large naval establishment being to use cannon and small-arms and torpedo explosives against public enemies, the question of ordnance is of the first importance. Having no effective guns, it is the duty of the Government to begin their manufacture immediately. This country is not now capable of making the steel forgings necessary for heavy rifled cannon; they must, therefore, either be produced abroad or inducements must be offered to steel manufacturers to engage in their production. There is no steam-hammer in the country sufficient for the heavy forgings required. Either through the agency of some private company or by the direct action of the Government, such a hammer should be prepared for American use."

American industry responded generously when Congress assured funds for the development of the existing steel plants that showed their readiness to engage in the costly and for them new departure of turning out the heavy forgings that would meet the exacting specifications of the Bureau of Ordnance of the Navy Department. Coincidentally, steps were taken to provide the Washington Navy Yard with the machinery required to manufacture the guns from the roughly bored forgings. It was then possible for the Navy to begin turning out the built-up weapons that were to win world-wide recognition because of their continually increasing excellence and striking power.

Starting in 1882 with the construction of the main batteries of 6-inch and 8-inch rifles for the first of the cruisers for the New Navy, the gun factory later undertook the building of 10- and 13-inch weapons. The latter were for our so-called coast-line battleships, those widely proclaimed armored craft of the early

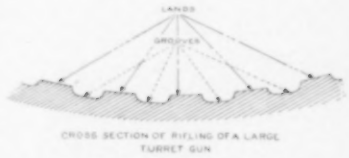
FIREPOWER

At the left, a 35,000-ton battleship is firing a salvo from three 16-inch rifles. Elevated to approximately 45°, the guns hurl their projectiles some 26 miles. A muzzle-loading 42-pounder that was typical of the heaviest weapons carried by our sailing ships in the War of 1812 is shown in the opposite corner. The 40-mm. guns in the bottom picture on the opposing page are designed primarily to repel attacking aircraft at close range. They can fire 120 times a minute and send their 2-pound projectiles a distance of 2 miles. The six 14-inch rifles in the two battleship turrets in the center can be fired simultaneously. At first glance the guns seen above all appear to be on one ship. Actually, as closer inspection will reveal, they are on three vessels—part of a flotilla of destroyers.



SECTION THROUGH A LARGE NAVAL RIFLE

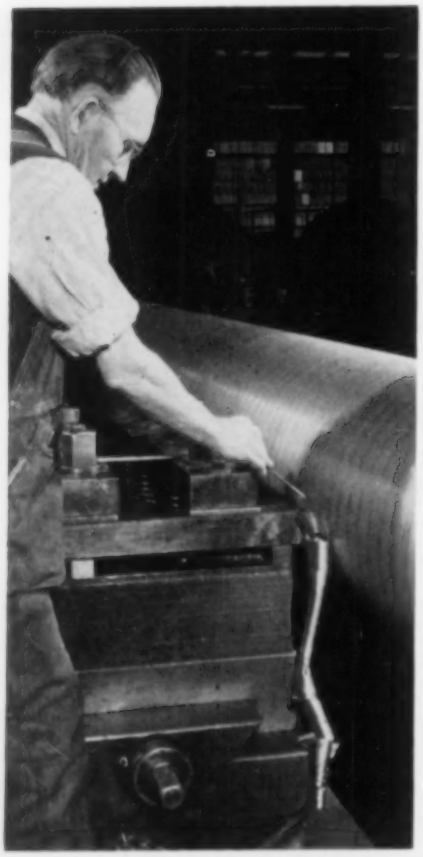
This drawing illustrates how a gun is constructed progressively from the inner tube out to the final enveloping hoop. It does not show the innermost liner that carries the rifling. Each member of a rifle's body is made of special steel.



CROSS SECTION OF RIFLING OF A LARGE TURRET GUN

"nineties." As work increased, the need of larger shops led to the virtual abandonment of all but the ordnance department at the Washington Navy Yard which, by order of the Secretary of the Navy in 1886, became, in effect, a naval gun factory. As our battleships grew in size and power of offense, 14- and finally 16-inch rifles were turned out; and in the future there may be still other advances because, as we have learned, unpreparedness is not only tremendously costly but fraught with national peril.

Today, the Naval Gun Factory occupies a far larger area than it did in the late "eighties" when it consisted of two small buildings. Indeed, it is said to be the finest plant of its kind in the world. In its aggregation of splendidly equipped shops it produces naval rifles of any size and description, gun carriages, cartridge cases for rapid-fire guns, powder tanks, and, among other things, sighting and fire-control instruments of the utmost precision that enable us to take advantage of the astonishing accuracy of our long-range weapons. Working under wartime pressure, the factory is operating to capacity 24 hours a day. This is necessary because of the great number of combat craft that has been and is steadily being added to our fighting fleet. As many of us may not be well informed about the Navy's rifles, the table below, compiled from official sources, should prove of interest.



MACHINING THE LINER

The ribbon of steel is only about two-thousandths of an inch thick and the machinist must keep close watch to make certain that he does not exceed the close tolerance allowed him.

In the tabulation, the term "ceiling" indicates how far skyward the 3- and 5-inch rapid-fire guns can hurl their projectiles in combating hostile aircraft. For that purpose the rifles are often mounted in pairs and can be swung around to bear upon a target approaching from well-nigh any angle. The precision of fire and the destructive power of the 5-inch, in particular, have amazed the Japanese and cost them heavily whenever caught within the blasting zones of the projectiles designed especially for antiaircraft service. Ponderous as are the guns of much larger calibers, they too can be trained horizontally and elevated for range with such accuracy and promptness as to astonish the layman. Many of the news releases concerning the effectiveness of our naval rifles in action in the Pacific have revealed how quickly, even under conditions impairing visibility, our gun pointers have been able to hit the targets at ranges of many thousands of yards. Indeed, the men behind the heavy-turreted rifles sometimes did not see the targets on which they scored. That precision is attributable to our fire-control methods, which the Navy naturally considers highly confidential.

As a matter of startling contrast, let us compare the long 24-pounders of the *Constitution* with the 1.1-inch naval rapid-fire gun of today. The 24-pounder used a cannon ball of that weight. It was usually brought into action at a range of 500 yards—frequently much less—and history has it that a well-trained crew could, under favorable conditions of the sea, fire such a piece once a minute. The present 1.1-inch fires a 1-pound projectile, can make 140 shots a minute, and has a range of 1½ miles. Such is the difference between the most powerful weapon carried by our sailing frigates during the War of 1812, and almost the smallest of the modern guns now mounted aboard our combat craft. What, then, will a naval rifle of 16-inch caliber do to an enemy vessel? We have the answer in what was done by the *U.S.S. South Dakota* which, for many months, was referred to only as Battle-

TYPICAL NAVAL GUNS AND THEIR APPROXIMATE CHARACTERISTICS

Gun Caliber	Range	Weight of Projectile	Shots Per Minute
16 inch	20 miles	2200 pounds	1
14 "	20 "	1400 "	1
12 "	12 "	900 "	1
8 "	15 "	250 "	2
6 "	15 "	100 "	8
5 "	10 miles, ceiling 6 miles	50 "	12
3 "	5 miles, ceiling 3 miles	12 "	20
40 mm.	2 miles	2 "	120
1.1 inch	1.5 "	1 "	140
20 mm.	1 "	¼ "	400
.50 inch	½ "	1/10 "	600

SHRINKING JACKET ON LINER

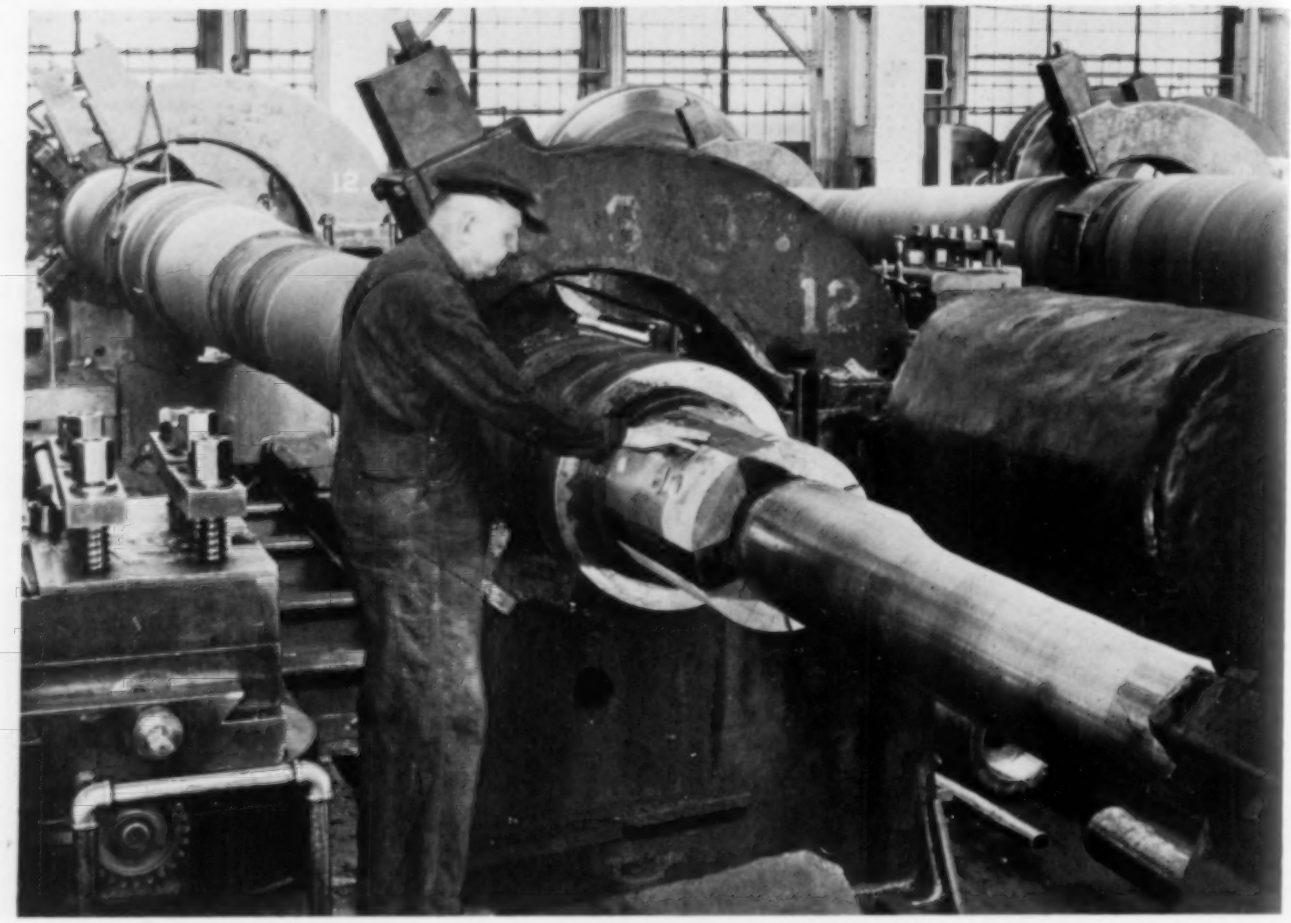
At the right, in the foreground, is a liner suspended directly over the shrinkage pit in which the main rifle assembly—which is standing unseen with its large or breech end uppermost—awaits its insertion. The other view shows the liner after it has been lowered and with all but its upper end in the gun, which is kept hot and expanded in the enveloping electric furnace.

ship *X* to add to the confusion of the Japanese.

One battleship armed with 16-inch guns in her main turrets, another heavy fighting ship, and a number of screening destroyers fought two groups of Nipponese battlecraft just after midnight on November 15, 1942. Three large Japanese vessels were faintly discerned at a distance of about 19,000 yards in the vicinity of Savo Island of the Solomon group, and the 16-inch salvos of our battleship tore two of those cruisers apart as though they had been chopped in two by a titanic cleaver, while our other large ship disposed of the third hostile vessel. The engagement was over in seven minutes! Shortly afterward, a Japanese cruiser was discovered nearly 3½ sea miles astern of our battleship and intent upon fleeing. Three salvos from the triple guns in the latter's after turret blasted that cruiser and sent her to the bottom in short order. That same morning the United States vessels encountered another enemy force of one battleship, two heavy cruisers, and a flotilla of destroyers. In 20-odd minutes the large craft of that hostile fleet were shattered, burning wrecks, and such of the foe's destroyers as survived scuttled away into the shadows of neighboring islands. At least one of the enemy capital ships was armed with 14-inch guns. If this record fails to make the destructive might of our big rifles understandable, perhaps a popular comparison will do so.

Conceive an express train made up of a steam engine, a tender, one baggage car, and three loaded Pullmans weighing about 215 tons and running at 60 miles an hour. That train, on colliding with an obstruction, will strike a blow of close to 26,000 foot-tons. The pent-up energy of a 16-inch projectile at the instant it leaves the muzzle of the gun will be more than four times that of the train, and remember that a ship like the *South Dakota* carries nine such guns and that all of them can be fired in a salvo and at a single target. It is because of this tremendous muzzle velocity that the impact of the projectile is so much greater than that of the big, heavy train.

The term caliber as used by the ordnance expert is often confusing to the layman because it has two meanings. A rifle of 12-inch caliber is one that has a bore 12 inches in diameter, while a 12-inch gun of 50 calibers, for example, has a bore length of 50 feet between its muzzle and the rearward end of the powder chamber where it is sealed by the breech plug. If one looks over a list of naval guns one will find that a number of them have the same caliber of bore but differ in caliber lengths. There are several reasons for this, but the main purpose in increasing the length is to add to a rifle's destructive power and range. For instance, by lengthening a gun of a given caliber five calibers, the muzzle velocity of the projectile discharged from it may be augmented sufficiently to increase the shell's penetration of defensive armor by fully 16 percent when the range is about 8 miles! The explanation for this is that the projectile travels farther in the bore of the longer rifle and is continually ac-



FINISH-BORING

After the liner has been put in place, it is finish-bored with a packed bit that is slightly larger than the existing bore so as to steady the tool as it makes its precise and slow passage from end to end of the gun.

celerated the while by the propelling gases of the ignited powder charge. In consequence, it leaves the muzzle with a greater velocity. The added energy thus stored in the shell will carry it a longer distance through the air and enable it to strike a harder blow when meeting an obstacle at any point in its flight.

The propellant that sends a projectile hurtling on its destructive journey is smokeless powder, some hundreds of pounds of it, perhaps. Paradoxically called "slow-burning," that powder, in the amazingly brief period of a hundredth of a second, develops the tremendous energy that starts the shell from standstill and builds up its velocity to the terrific speed with which it leaves the muzzle. Guns must be strong safely to withstand such bursting stresses, and the weapons turned out at the Naval Gun Factory are fabricated of steels that meet very exacting requirements and with such care and fine workmanship that even the largest of them may be fired several hundred times before it has to be returned to the plant for repairs.

Because rifles of many different calibers are manufactured at that great plant for the various types and sizes of our combat ships, we shall have to limit ourselves to only one caliber, and perhaps it will be of most interest if we follow the construction stages of a 16-inch gun. The body of such a weapon weighs in excess of 100 tons, and the carriage on which it is mounted weighs something less, but it must be heavy and strong enough to absorb the recoil and to restrain that rearward drive within the amazingly short travel of about 5 feet. As action and reaction must balance, it is understandable that the mount has to be ingeniously designed and every part made and put together with the utmost precision. Recoil is arrested by a hydropneumatic system that also returns the rifle to the reloading position through counterrecoil.

When the big guns of the Navy could elevate their muzzles about 15° to get the ranges then prescribed, the "kick" at firing was absorbed by a number of powerful springs housed in tubes. Those springs, after momentary compression, reacted to operate the counterrecoil system that brought the rifles back "into battery." Later, when elevations were increased to permit still longer ranges, the springs had to be abandoned for a pneumatic system by which plungers move inward against air confined in cylinders at a pressure of about 1800 pounds per square inch. The plungers are fitted with a special type of packing that remains tight when moving backward against the compressed air because it is kept moist by a liquid—hence the designation hydropneumatic system of counterrecoil. When the plungers are driven against the compressed air, the pressure in the cylinders is further increased about 50 percent; and the packing would fail of its purpose if the air could escape around it instead of forcing the plungers outward again and moving the weapon back into position for reloading. The problem of keeping the packing tight was solved by utilizing the recoil of the gun, in part, through the medium of a differential cylinder that serves to increase the hydraulic pressure so that it sufficiently exceeds the pressure of the air in the pneumatic cylinders during the recoil and counterrecoil movement of the gun and carriage.

Above the 8-inch, all naval rifles are of the built-up type, that is, their bodies are composed essentially of a long inner tube on which are shrunk cylindrical

forgings of varying lengths. The larger number of these hoops or jackets are arranged concentrically around the rear section where the greatest measure of strength is needed to resist the high and sudden pressure developed when the powder charge is first ignited and when those impulse gases are overcoming the inertia of the projectile and accelerating it toward the muzzle. All these cylindrical forgings are supplied by companies that specialize in that work, and the steel for each forging is of a composition that provides the exact strength and elasticity demanded at the point where it encircles the gun's body. The innermost forging forms the tapered liner of the bore. This has to be of the finest steel because it carries the rifling and has to bear the intense heat of the propelling gases as well as the erosive action of the projectile to which the rifling imparts the rotary motion that steadies it while racing through the air toward a target.

Each rough forging, if found acceptable, is bored and machined to a tolerance of one-thousandth of an inch, and the machinists must do their work with a precision that would not shame a watchmaker. After boring, it is subjected to "star-gauging"—the starlike points of fingers of the instrument registering diameters to the nearest thousandth of an inch. The bore of the jacket is further examined by means of an electric bore-searcher which carries an arrangement of mirrors and lights that permit not only inspection of every part of the interior but the taking of photographs as well. It is next to impossible for any surface defects to pass unnoticed.

Assuming the inner tube and its immediate jacket to be ready for assembling, the latter is placed in an electric furnace connected with a shrinkage pit; and it is worth noting that one of the pits is 100 feet deep. The furnace is in sections to handle forgings of different lengths, and the temperatures maintained may range up to 800°F., depending upon the size of the forging and the measure of shrinkage desired. The inner tube on which the jacket is to be shrunk is set up on a table at the bottom of the pit and firmly held there with its muzzle end uppermost. It can be kept cool with circulating water to prevent it from absorbing heat and changing its own diameter as the heated jacket is lowered down over it. This is done after the outer surface of the tube has been coated with a mixture of light oil and graphite to facilitate slipping on the jacket which has been heated sufficiently to give it the necessary clearance. When cool, the jacket will grip the inner tube forcibly because it will remain slightly distended and under initial tension. In principle, the succeeding reinforcing hoops are finish-bored, machined, examined, heated, and shrunk on one by one, as described.

The final job of assembly after the gun has been conically bored is that of inserting the tapered liner. For this operation the weapon is placed in the electric furnace, but with its muzzle end down. When it has been heated to the required degree, the liner is lowered into it and filled with water so that it will not absorb heat and expand, which might prevent it from slipping into position. So built up, the gun is ready for the subsequent work of machining the bore of the liner to final diameter—the allowed tolerance being only two-thousandths of an inch oversize and zero undersize—and of chambering the breech end of the bore for the powder chamber which is larger in diameter than the long bore.

After chambering, the weapon is fin-

CUTTING THE RIFLING

The crucial operation is that of cutting the spiral grooves or rifling in the liner. The picture below is a close-up of the rifling head with its crown of many tools each of which cuts a groove. The other view shows the opposite end of the gun during the operation. The stream of lubricating oil first serves the cutting tools and then carries the steel chips through the gun, getting them out of the way of the advancing rifling head.

FINISHING BREECH END

At the left, the breech end is being made ready to receive the screw-box liner in which the breech plug will be housed. The other view shows the plug swung out and down into the position that permits loading the rifle. Above the man's head is the line through which a blast of compressed air is blown into the gun before the breech is opened after firing so as to remove any residual gases and smoldering particles. On a level with his elbow is another air line that supplies power to help lift the breech plug into position for closing. Note the interrupted threads on the breech plug and on the screw-box liner that intermesh when the breech is closed.

ished externally by machining the surface to the prescribed finished dimensions with lathes that are not only immense but wonderful examples of the toolmaker's engineering skill. And now we come to the climacteric stage of production—that of cutting the rifling which extends from the forward end of the powder chamber to the muzzle. For this purpose, a wonderfully conceived tool—a rifling head—is used. The forward edge of this hollow cylinder is equipped with numerous tools of which there are half as many as there are grooves to be cut in the bore liner.

For a 16-inch gun there are 48 tools. When they have cut half of the grooves, the rifling head is rotated to bring it into the precise position for cutting the other 48. At each pass the tools remove one and a half thousandths of an inch of metal, and the rifling head makes 750 passes through the long bore to complete the 96 spiral grooves which may range in depth from ½ to 1 percent of the caliber of the weapon. The lands of the rifling—the projecting flat surfaces that are left in the bore after the grooves are cut—press into the soft copper rotating band that surrounds the rear section of a projectile and, when the gun is fired, cause the shell to acquire a spinning motion of increasing velocity as it travels muzzleward. This action keeps the head of the missile continually foremost and assures a maximum range of flight, accuracy, and effective penetration when the projectile strikes a wall of steel.

To build a 16-inch rifle up to this point requires several months of work, with the skilled artisans on the job three shifts daily. While the gun body is under construction, other craftsmen are fabricating the breech block, which also takes months to manufacture. The latter is something of a mechanical marvel and calls for the highest kind of workmanship and a great deal of hand fabrication because the permissible tolerances are very small. The breech plug has to fit snugly into the screw-box liner at the breech of the weapon, sealing it securely so that none of the explosive gases can escape rearward. These gases have a temperature of about 2000°F. and develop a pressure of more than 15 tons per square inch! The locking surfaces of the breech block engage locking threads in the wall of the screw-box liner when the plug is rotated, and blank spaces on both the breech block and the screw-box liner make it possible to slide the block directly into the breech before rotating and locking the plug for firing or to withdraw it for opening the breech for reloading.

A single downward pull on a lever unlocks the breech block and drops it clear so that the gun can be loaded—the projectile and powder charges being shoved mechanically into their proper places. Before the plug can be retracted following firing, a blast of air at a pressure of about 175 pounds is discharged into the rifle to blow out highly heated residual gases and any burning particles that may remain in the bore. And compressed air, reduced to a pressure of 35 pounds, actuates a mechanism that helps to lift and to shove the heavy breech block into position when closing the weapon after reloading. Without the aid of compressed air it would take three men instead of one to handle the block.

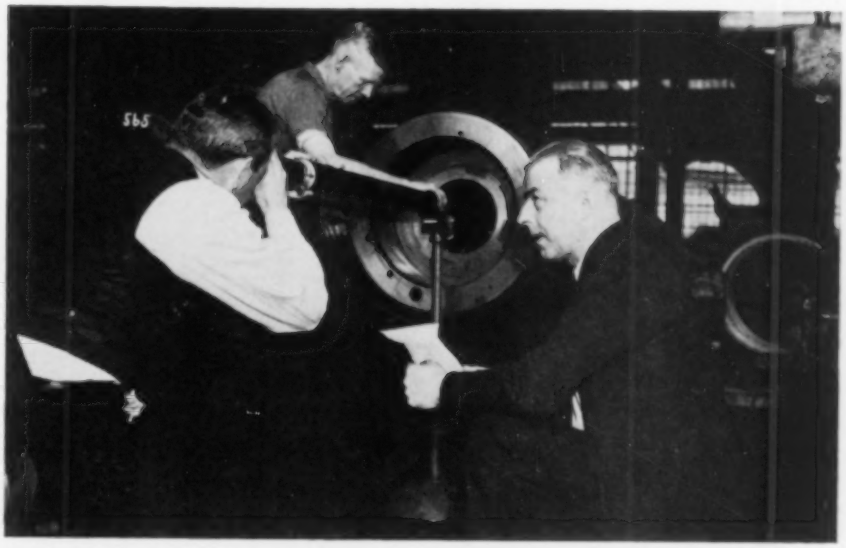
Normally, the life of one of these great guns and its accuracy are mainly dependent upon the condition of the liner and its rifling. The latter may become impaired through the erosive action of the heavy rotating projectiles and the contributory intense heat and high pressure of the impelling powder gases. Therefore, to restore such a weapon to service fitness, the damaged liner has to be extracted and a new one inserted and rifled. This is done by threading the breech end of the liner so that a pulling apparatus can be attached to it, and then the rifle is lowered into one of the electric furnaces and heated to a temperature of 600°F. at the muzzle end and 550° at the breech end. This is possible because the encircling units of the furnace are susceptible of independent control. When the gun is sufficiently heated, refrigerated water is circulated rapidly through the bore of the liner. The resultant contraction permits the tapered liner to be

unseated by hydraulic jacks and lifted clear of the pit by a crane. It has been found possible to reline some rifles a number of times.

Naval guns of 8-inch caliber and less are not built up as described, but are manufactured by what is known as the radial-expansion system. Caliber for caliber, the weapons so constructed weigh less than the jacketed or hooped type. For instance, an 8-inch radially expanded rifle is several hundred pounds lighter than a built-up 8-inch, and yet there is no sacrifice in muzzle velocity. Apart from the saving in weight, a radially expanded gun is said to be stronger and to withstand higher explosive pressures, thus giving the projectile greater range and destructive power.

An 8-inch rifle can be made of two forgings—of a jacket and an inner tube. The hollow inner-tube forging is turned down approximately to its maximum outside diameter and is then accurately bored to a diameter slightly smaller than the prescribed final dimension. Next, both the breech and the muzzle are bored and tapped to receive screw plugs. With the plugs and their packing in place, the intervening bore is subjected to nicely regulated hydraulic pressure that may be intensified to 45,000 and 100,000 pounds per square inch. That pressure uniformly expands the semiplastic metal —symmetrically deforms it, and without destroying its elasticity imparts to it a permanent set that makes it stronger than it was before, capable of more readily absorbing the sudden stresses set up by the burning powder. The jacket is then shrunk on over the inner tube.

When a big turret gun is completed, it is carried by overhead cranes of 100 to 200 tons capacity from the erecting shop to a large pit where it is lowered on to a mount that has been assembled there for it. By doing this under cover, instead of on the waterfront as formerly, much time and transportation are saved, and the weapon in relation to its mount, and the mount itself, can be subjected to shop tests to make sure that all the mechanical features are in perfect order. Compressed air is used in the pit to operate the counter-recoil system and to perform other essential functions in disclosing the working condition of the gun and its mount. The latter must absorb most of the forces developed during recoil so as to minimize the stresses transmitted to the structure of a ship.

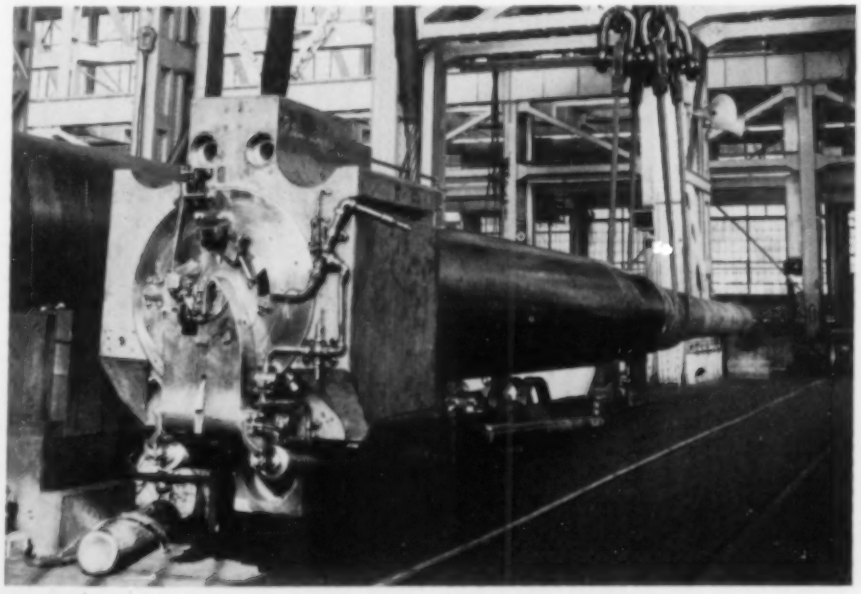


FACTORY INSPECTION

This apparatus carries an electric light for illuminating the interior of a rifle and provides magnified vision with means for locating exactly any flaw that may be present. The performance of a gun and the safety not only of the gun's crew but of the ship itself may hinge upon the thoroughness with which this search for defects is carried out.

Compressed air performs many services in the numerous shops of the Naval Gun Factory, the maximum requirement being 9000 cfm. at a line pressure of 105 to 108 pounds. To provide a suitable reserve, a total compressor capacity of 15,000 cfm. is available, of which 8000 cfm. is supplied by two Class PRE-2 machines. Compressed air is also used extensively in two foundries, machine shops, and in the shop which makes the fuses that time the detonation of the charges in projectiles. Precision of functioning depends upon the thorough cleaning of the fuse parts before assembly, and compressed air is delivered to each bench for that purpose.

Guns turned out in the Washington Navy Yard are of such well-proved excellence because, to quote a former inspector of ordnance at the Naval Gun Factory, "The interest of every man in the plant is to do the best work. Our men, and there are plenty of them who have been 30 to 40 years connected with this work, take the same interest in the shops that they would if they owned them." Large as the factory is today, it cannot provide all the weapons for our battle fleet and for the ships built by the U.S. Maritime Commission for wartime service. Therefore the Navy has to turn to private enterprise for some of our ordnance matériel. According to Rear Admiral W.H.P. Blandy, U.S.N., until a few months ago Chief of the Bureau of Ordnance, "Fifteen naval ordnance plants, 1800 prime contractors, and 25,000 subcontractors produce this seagoing armament."



BOUND FOR THE PROVING GROUNDS

One of the main turret guns of a battleship ready to be lifted from the floor and sent to the Naval Proving Grounds, down the Potomac River, for test-firing before placing it aboard a vessel.

Pharmaceuticals by Roche

Allen S. Park

A MODERN PLANT IN A SUBURBAN SETTING

If the firm's name were not displayed, one might easily mistake the Hoffmann-LaRoche factory at Roche Park, Nutley, N. J., for a college or a hospital. The center view shows the entrance to the 104-acre plant site. Above is pictured a corner of the ampul room, where immaculately clad girls fill small glass flasks with accurately measured quantities of liquid medications.

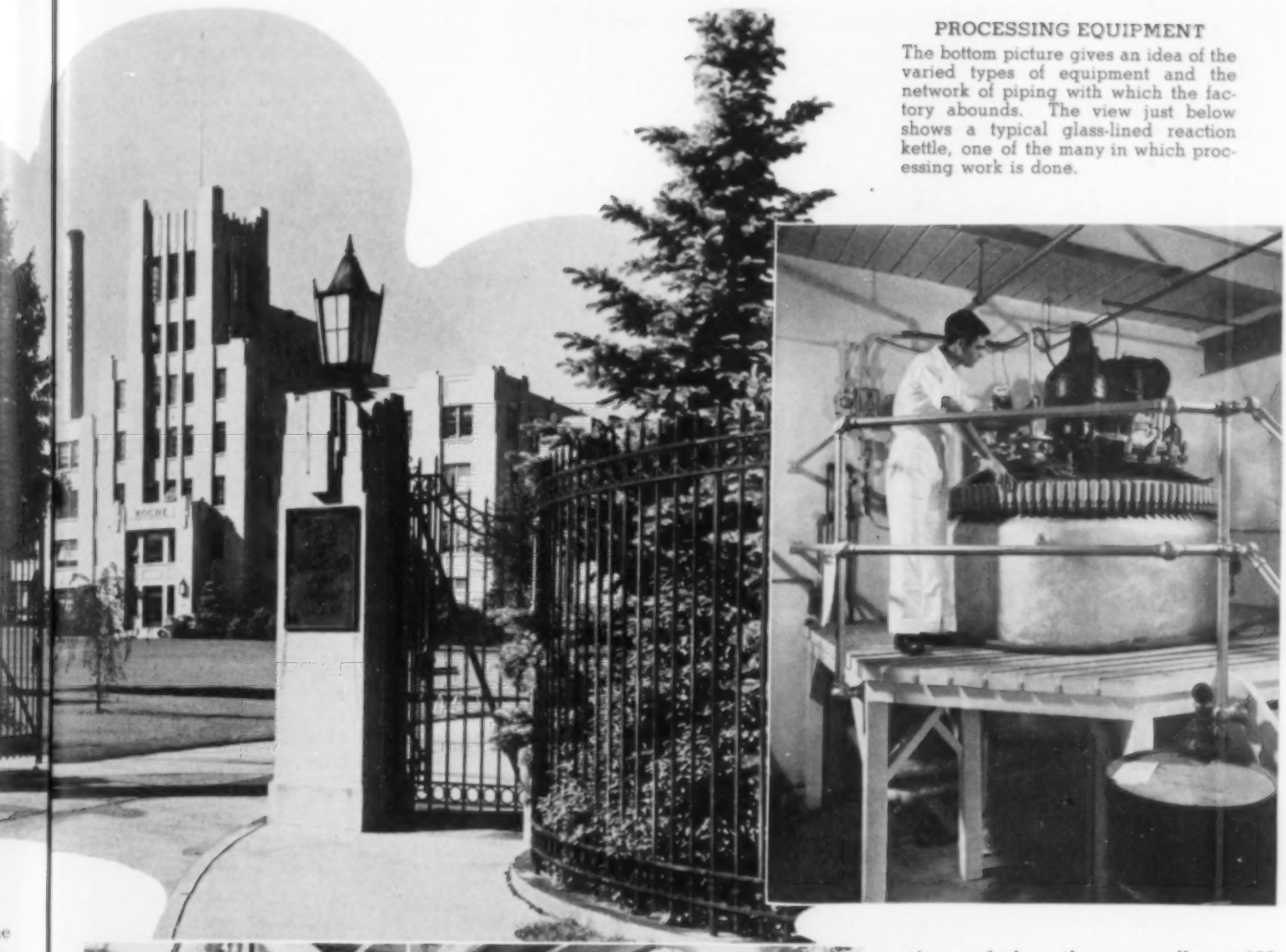
VIRTUALLY all the medicines available a century ago came from crude vegetable extracts and a few inorganic salts. The development of organic chemistry made it possible to produce chemical substances of known composition, and these replaced the earlier preparations of unknown strength. Then followed the synthesis of organic compounds which multiplied the number of substances available to the physician. The anesthetics ether and chloroform, which were produced about 100 years ago, were the first synthetics to be used extensively. After their appearance the field of chemical endeavor widened, gradually at first and then precipitately, and from it have come countless preparations on which medical science can call. This research is at a new peak right now, and some of its recent fruits are the vitamins and the spectacular new antibactericides—the sulfa drugs and the mold-growth product penicillin. The development of the latter substances has been greatly spurred by the wartime demand for powerful and effective wound antibiotics.

The present important pharmaceutical industry differs distinctly from the industry of a few decades ago. The public knows the names of some of the leading makers of pharmaceuticals because they advertise certain of their products to the consumer. But there are other firms prominent in the field about which the average person rarely hears because they sell their preparations only through the medical profession. One such concern is Hoffmann-La Roche, Inc., which has been in business in the United States since 1905. At that time it started as the Hoffmann-La Roche Chemical Works, Inc., of New York City, an American offshoot of F. Hoffmann-La Roche Company which had been founded in Basel, Switzerland, in 1896.

As physicians became more and more familiar with Roche medicines, several homes were successively outlived until, in 1928, a 22-acre tract was purchased in New Jersey. There a new plant was erected, which was considered ultra-modern in drug-trade circles, and the concern moved in the following June, incorporating under the present name of Hoffmann-La Roche, Inc. New products meant new manufacturing needs, so more structures had to be put up and more acreage acquired. Operations are international in scope, many much-needed drugs being supplied to the Allies. The company is also building up one of the largest businesses of its kind in the Latin American countries. Research, which is all-important in the pharmaceutical field is carried on extensively in the Nutley laboratories.

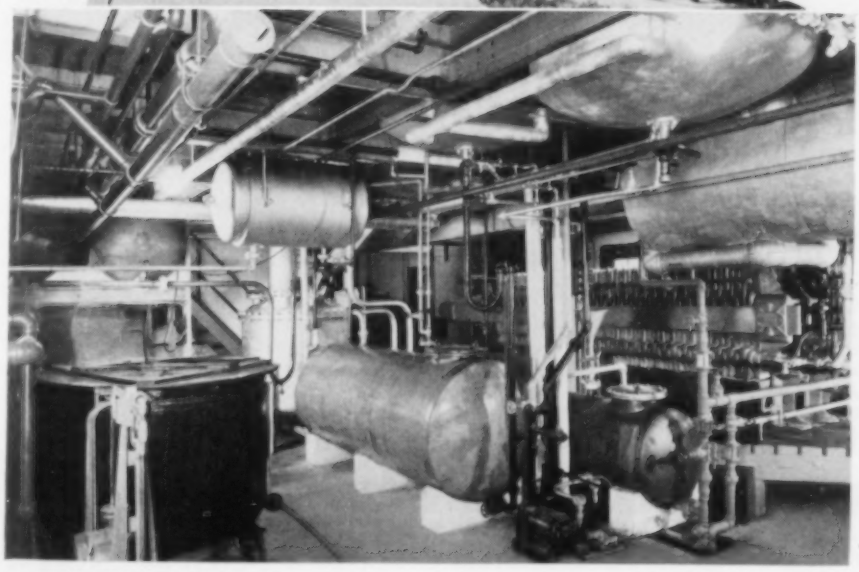
The grounds, known as Roche Park, have been increased from the original acreage to its present expanse of 104 acres. The employees now total upwards of 1700, and the buildings number more than two dozen. Plans for additional structures had to be curtailed when the war brought about a shortage of building materials; but, even so, a new pharmaceutical building and a second powerhouse have been erected in recent months. In addition to the facilities at Roche Park, warehouses have been leased at nearby cities for the storage of materials required for the mounting vitamin production.

Sales policies of the organization are in keeping with the ethical standards of



PROCESSING EQUIPMENT

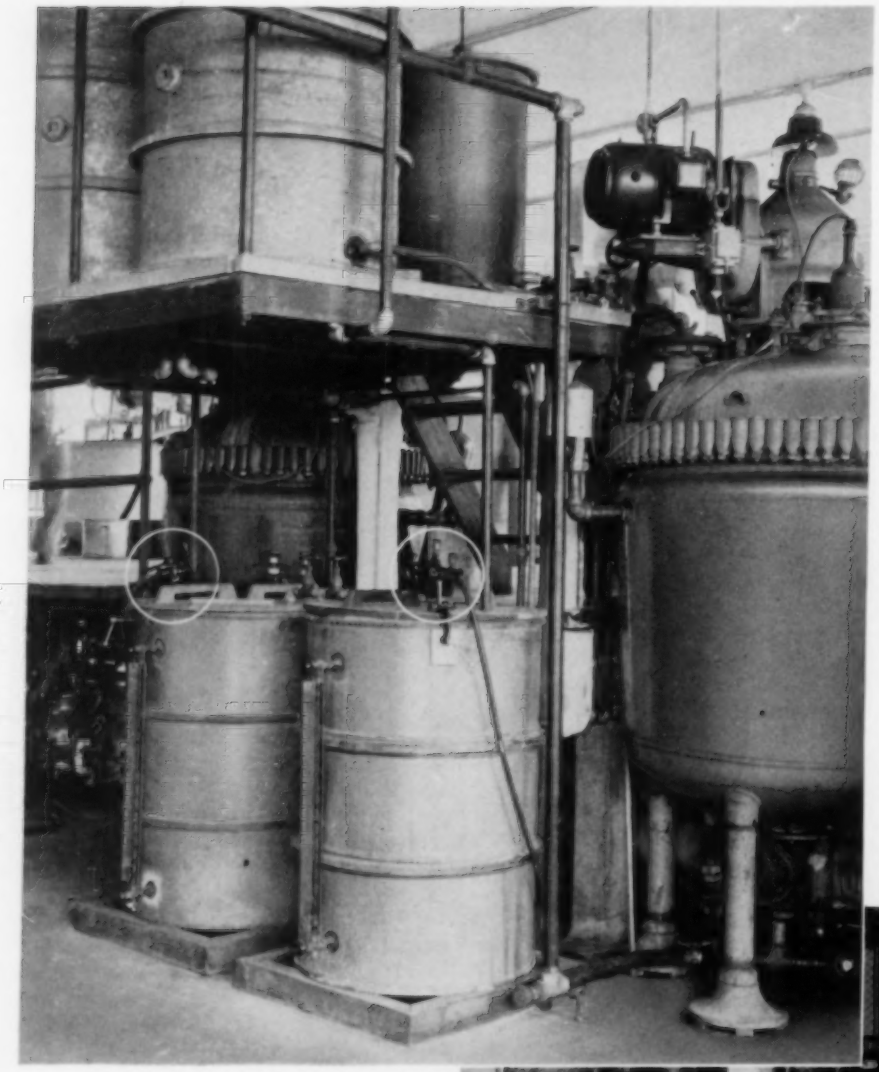
The bottom picture gives an idea of the varied types of equipment and the network of piping with which the factory abounds. The view just below shows a typical glass-lined reaction kettle, one of the many in which processing work is done.

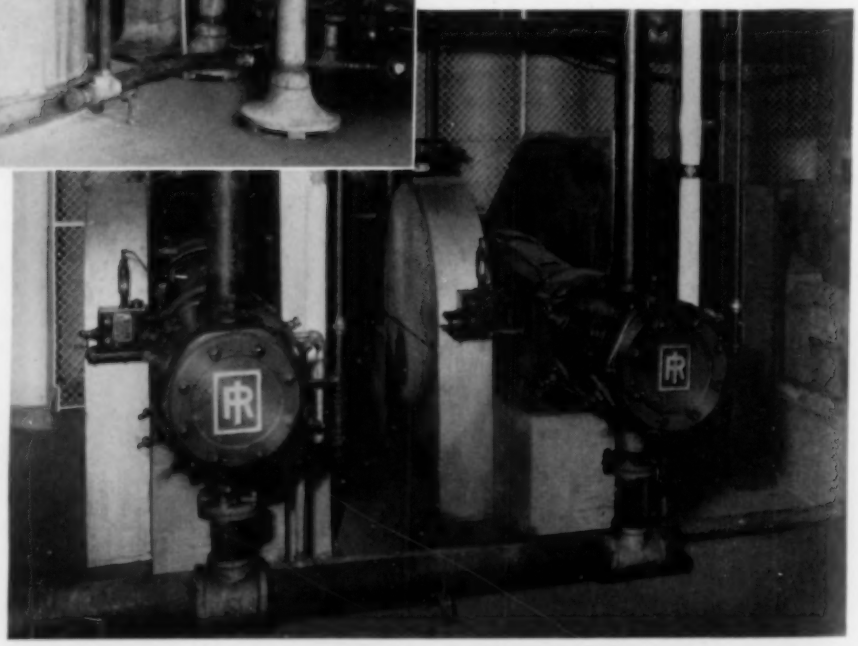


the medical profession it serves. It advertises in leading medical journals and also distributes literature regularly to doctors, dentists, pharmacists, and hospitals in the United States and in various other countries. These mailings describe the products and give pertinent information concerning their properties and applications as determined through systematic experimentation carried on in the laboratories. Considerable quantities of its pharmaceuticals go out by parcel post. The company's postage bill approximates $200,000 annually, and a separate post office is provided to handle the outgoing mail, which often fills 500 bags a day. In addition to its direct-mail sales-promotion activities, its representatives—of whom there are well over 100 in the United States—spend all their time making contacts in the medical field. These men are trained for their work, and their primary function is to keep the firm's clientele informed about new Roche products and new applications of existing ones. They are not salesmen in the sense of being order-takers but, rather, educational missionaries.

From a few original pharmaceuticals, the company's line has expanded to some 40-odd specialties. During the first years, the principal products were Digalen, Thiocol, and Pantopon. Digalen is a specially processed preparation of digitalis and can be administered by injection as well as by mouth in the treatment of heart ailments. Thiocol is a cough remedy that is derived from guaiacol, and Pantopon is a product of whole opium that is applied by injection. Physicians still prescribe all of them.

Starting around 1920, various other preparations were added, the first ones being Allonal, Sodium Alurate, and Sedormid, which are used in the treatment of nerve tension and insomnia. Since then the list has steadily lengthened. Prominent among recent additions are Syntropan and Prostigmin.





The former is a nonnarcotic antispasmodic drug that has received widespread recognition as a substitute for atropine and belladonna, both of which have been difficult to obtain since the current war broke out. Prostigmin is one of the most outstanding preparations of the past decade. It is widely administered to prevent urinary retention and abdominal distention which frequently develop after surgery. It is also being used by physicians with great success in the diagnosis and treatment of myasthenia gravis, a disease that results in a form of paralysis that usually leaves its victims helpless. Important experimental work has recently been started w th Prostigmin in the treatment of certain aspects of infantile paralysis.

Besides making up its own preparations, the firm has always produced a group of medicinal chemicals for sale to other pharmaceutical manufacturers. Among these, quinine and strychnine have held leading places for many years, while the sedative drug barbital and allied compounds have latterly become prominent.

In addition to the aforementioned pharmaceuticals, Hoffmann-La Roche has in recent years become such a large-scale manufacturer of vitamin preparations that literally tons of several different kinds are now made every month. It was one of the first concerns to enter this fie'd, and its research has contributed materially to the development of the synthesis of several vitamins. These Roche preparations are produced in tablet, powder, and liquid forms, the latter having the advantage that it can be readily administered to infants. One of them is a chocolate-flavored powder that can be added to milk. Last fall the firm introduced a new multivitamin-mineral product, called Vitaminets, which incorporates nine vitamins and five minerals in a licorice-flavored tablet that can be chewed or swallowed whole.

Vitamin C, which is also called ascorbic acid, is supplied by the company to pharmaceutical manufacturers and to food processors for addition to their products. A powdered citrus concentrate containing Vitamin C is incorporated in special scientific rations that are now furnished to our military forces. When mixed with water, it provides a beverage that is as rich in Vitamin C as is the juice of fresh citrus fruit. This vitamin is produced on a large scale, as is vitamin B_1, or thiamine, which is likewise added to foods. The latter is used by bakers for the enrichment of white flour and bread, a government regulation that has been in force since January, 1943.

The Roche laboratory was the first to synthesize Vitamin B_2, or G, and the company is now one of its greatest producers. This vitamin, which was originally known as lactoflavin and is now called riboflavin, has been added in definite amounts by government order

HOW COMPRESSED AIR SERVES

Compressed air is used principally for transferring liquids by displacement and for operating agitators such as the two Eclipse Air Brush Company Pneumixes encircled in the picture at the top. They are agitating caustic solutions required in the manufacture of one of the B vitamins. Air motors serve wherever there is need for explosion-proof equipment. Compressed air for all plant purposes is supplied by four Ingersoll-Rand single-stage compressors, of which two are shown.

to flour and to all white bread produced by commercial bakers since last October. Today it sells at a small fraction of its original cost.

Contributing to the need for expansion was the formation in 1937 of a subsidiary concern, Roche-Organon, Inc., which manufactures endocrine and hormone preparations for prescription by physicians. Marketing of its products in foreign fields has also made demands upon the plant at Nutley. Although the war has interfered with shipments to some parts of the world, it has increased business in others, notably in South America.

The character of the operations requires, of course, that they be directed largely by men of scientific training, and there are many of them on the staff. It includes fourteen medical doctors, 150 chemists, and 40 persons who hold the degree of doctor of philosophy. To aid in the research that is the lifeblood of the organization, an outstanding library of medical literature has been built up. In its thousands of books and periodicals is to be found much of the medical and scientific information that is available to the world today, and liberal use is made of these facilities.

Because of the nature of its products, the factory at Roche Park differs from the usual run of industrial plants that are described in this publication. Essentially, it is engaged in an aggregation of individual manufacturing operations, each calling for its own raw materials and its own processes and each arriving at a different end product. Much of the equipment used is likewise distinctive. To guard against contamination and corrosion and to insure the ultimate in sanitation, glass-lined vessels, ceramic ware, and glass piping are generally employed, supplemented by noncorrosive metals such as stainless steel and nickel alloys. Compared with the heavy industries, individual pieces of equipment are small, as is to be expected where processes must be kept under precise control and where the products are ordinarily measured in ounces or small fractions thereof. However, what the equipment lacks in size is more than made up in numbers, there being literally scores of rooms filled with it. Much of it is specially built to specifications originating in the company's engineering department.

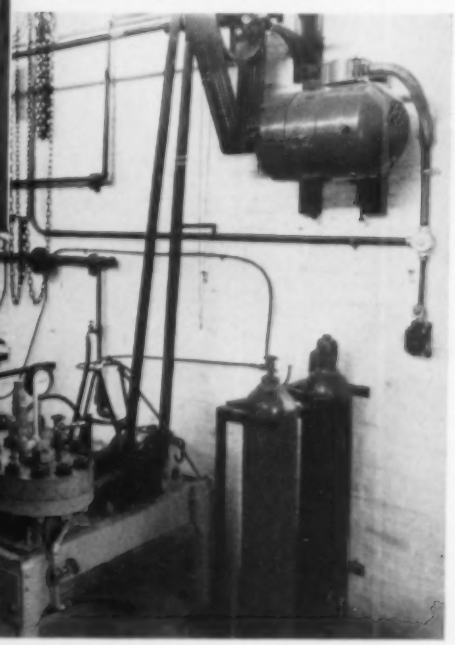
Another striking feature of the plant is its diverse uses of the utilities—of steam, water, electricity, compressed air, and various gases. Many manufacturing establishments employ one or more of these in large quantities, but at Nutley, with the exception of gas for heating, all of them enter into the operations. Because of the presence of flammable solvents and materials, no open fires are permitted, and smoking is prohibited throughout the production areas.

Steam is generated at 120 pounds pressure in six boilers with an aggregate capacity of 2000 hp. It is used at varying pressures for distillation and evaporation; for the operation of steam-jet ejectors in process work; and for heating the buildings in cold weather. Four-fifths of the condensate is returned to the boilers for reëvaporation.

Electric current is purchased and comes in at 4160 volts, being reduced to different voltages at several transformer stations. The largest use of power is for operating motors. As nearly all pieces of equipment have individual drives, there are a great many motors averaging 5 hp. or less. Electricity also serves to heat heating-reaction kettles when temperatures are needed higher than those obtainable with steam, and it replaces steam in cases where close temperature control is desired. Some conversion of alternating current is affected by means of motor-generator sets to provide direct current of low voltage and high amperage for electrolysis.

The consumption of water averages 90,000,000 gallons monthly. Much of it is required for cooling purposes, and in the summertime the regular city supply is supplemented by well water to take advantage of its lower temperature. Considerable quantities of water used in process work are demineralized or distilled.

Compressed air is furnished by a central plant consisting of three Ingersoll-



RESEARCH FACILITIES

A section of the research chemical laboratory is seen above. The other picture, taken in the developmental section, shows high-pressure equipment. The apparatus in the foreground is a shaking autoclave.

Rand single-stage Class ES machines, and another unit of the same type is located in a different building. Air consumption averages 5,000,000 cubic feet per month. Many liquids that would corrode pump parts are transferred with air under pressure, and air motors are extensively employed to operate mechanical agitators for stirring or mixing solutions. Such air-driven equipment is utilized wherever there is a fire or explosion hazard. Direct agitation with air is not practised because it would have an oxidizing effect on organic materials, which are widely used. Compressed air is also employed for cleaning. The air is distributed and applied at 30 pounds pressure, this being the maximum safe working pressure that can be exerted against some of the glass-lined and ceramic equipment from which liquids are transferred by displacement. Lower-pressure air for fermentation processes is supplied by blowers.

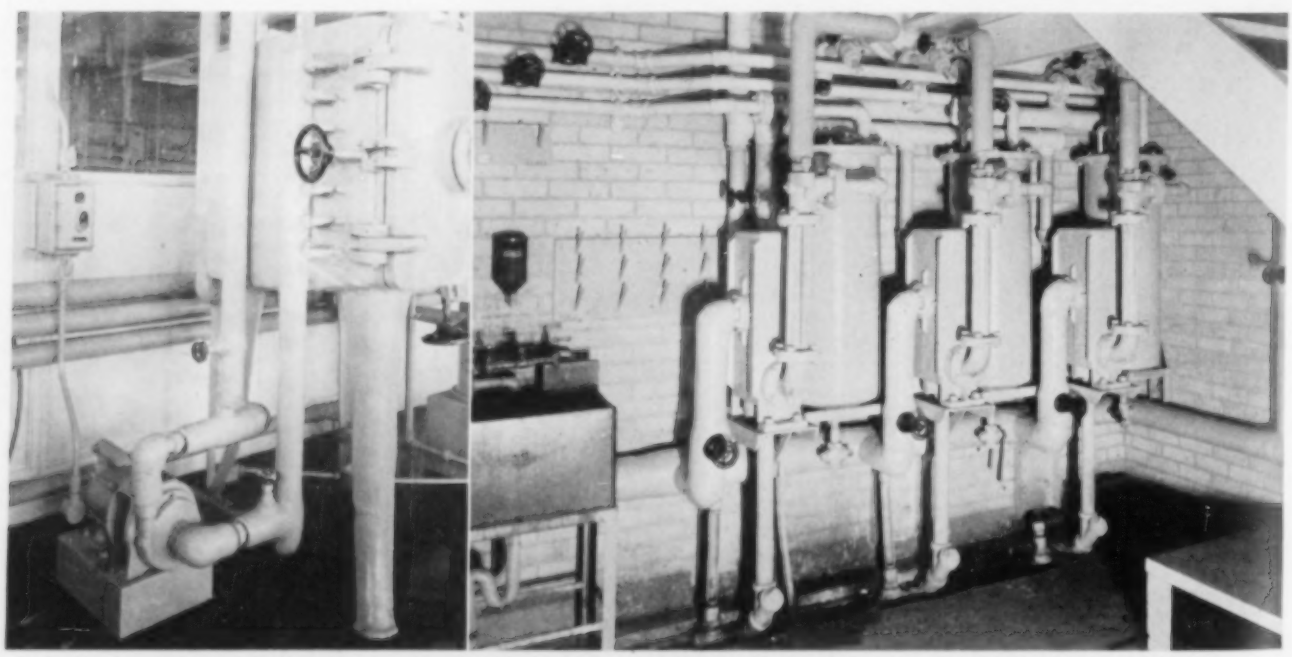
In addition to compressed air, vacuum plays an important part in evaporation and distillation processes. Various types of vacuum equipment are installed, the choice depending upon the service conditions in each case. This is also true as regards much other equipment, which must be tailor-made to fit requirements. Mechanical vacuum pumps were generally utilized when the plant was built, and they are still used for many purposes. In recent years, however, steam-jet ejectors have been adopted to induce vacuum for many applications that are within their range. These units have no moving parts, and their maintenance cost is generally low. They have greater resistance to corrosive materials than mechanical units, but for extremely corrosive conditions the jets are carbon-lined. Steam jets take up less space than do other types of vacuum equipment, and they can be and often are mounted high up on walls. Single-stage and 3-stage units are in general use and operated with steam at 75 pounds pressure.

Refrigeration enters into many of the processes and is provided in various buildings by individual ammonia-compressor systems circulating brine generally at a temperature of 14°F. Extremely low temperature, needed principally for laboratory work, is obtained by means of dry ice, and its consumption averages 15,000 pounds monthly.

Oxygen, hydrogen, and nitrogen also are essentials in the processing operations. The demand for oxygen is so great that the Linde Cascade system of cylinders has been installed as a central source of supply. The cylinders are filled once a month with liquid oxygen that is delivered at the plant, where it is piped to the points of application. Hydrogen is required for hydrogenation and is received in cylinders at a pressure of 2000 pounds. Where hydrogen is used, it is blanketed with nitrogen to prevent it from being ignited. Nitrogen also serves for scavenging equipment that has contained hydrogen.

Large quantities of solvents are stored in individual containers, some of them underground, constituting a central, outdoor tank farm. Among those most widely used are acetone, methanol, benzol, caustic soda, and anhydrous alcohol, as well as nitric, sulphuric, hydrochloric, and acetic acids. To house the piping systems by which these and the various utilities are distributed throughout the plant it was necessary to provide an underground, concrete-lined tunnel. It is 5x7 feet in section, approximately a mile long, and describes a complete loop that brings it under or close to all the buildings.

One of the reasons for establishing the factory at Roche Park was to give it an attractive suburban setting offering fresh, clean air and other favorable manufacturing conditions. The grounds have been landscaped and elaborately planted with shrubbery, and every effort is made to promote cleanliness and sanitation. By the same token, the company has taken precautions to make sure that its activities will not give offense to the community of which it is a part. Two buildings in which unsavory odors originate are kept under a slight vacuum, and the air exhausted from them is passed through activated carbon before it is permitted to escape. Ducts carry off the air from locations where the odors are concentrated, and the air throughout the buildings is changed frequently. In one structure a volume of 12,000 cfm., is circulated, and in the other 8,000 cfm. All plant sewage is treated before it enters disposal lines, between 2 and 3 tons of lime being used daily to neutralize acid solutions.



AIR JETS AND PUMP

Included in the various types of vacuum-inducing equipment are steam-jet ejector units. An ejector consists essentially of a nozzle discharging high-velocity steam across a suction chamber, thus withdrawing from it and entraining air or gases. The stream is then directed into a venturi-shaped diffusor which serves to increase the pressure. Shown at the right are three Ingersoll-Rand single-stage ejectors in the vitamin plant. The oblong vessels are after-condensers for condensing the steam and thereby adding to the economy of the units. The other view is of a Cameron centrifugal Motorpump that circulates hot water through a vacuum drier.

New Bridges Unite the Americas

Edwin W. James

IN CENTRAL AMERICA

At the top is the Cuscatlan Bridge across the Lempa River in El Salvador, a $700,000 structure that was paid for entirely by the Salvadoran government. It is the longest (1350 feet) suspension-type bridge in Central America. The other view shows the Choluteca Bridge in Honduras.

NEW bridges along the Pan American Highway route extending through eighteen countries are playing the vital but little-publicized role of tying the Americas together and of accelerating the development, production, and transport of critical war materials. Of special importance are the international bridges now linking ten of the American republics. The latest of these to be completed is the 480-foot Rio Goascoran highway span connecting El Salvador and Honduras.

The war-born need of improved land communication, particularly in Mexico and Central America, is responsible for the increase in bridge and roadbuilding in the Americas. The Corps of Engineers, U. S. Army, did a great deal of work in pushing a "pioneer" road through gaps in the highway in Central America before they withdrew on October 31, 1943, because their services were more urgently needed elsewhere.

Although the bridge and road-construction program has greatly reduced the number of unspanned streams that traverse the Pan American Highway route between Laredo, Tex., and Buenos Aires and Rio de Janeiro, considerable bridge building still remains to be done in southern Mexico, Nicaragua, Costa Rica, and northern Panama, as well as in South America. One of the gaps in southern Mexico—a 145-mile stretch between Comitan and Tapachula—presents such obstacles to bridge and highway engineers that there is some doubt as to whether the Mexican Government will be able to finish that section of the international highway before the war ends. There the route crosses the Sierra Madre range at an altitude of 6500 feet. However, construction is going ahead on the precipitous sides of the mountains from Tapachula near the Pacific Coast. President Manuel Avila Camacho recently told the nation that the administration proposes to make every effort to continue work on the project. As he put it, Mexico considers completion of her section as "an obligation to the countries of the hemisphere."

Meanwhile, bridges are being erected along the Inter-American Highway route in Costa Rica by the Public Roads Administration of the United States Federal Works Agency. In South America, some still remain to be built at several points in the Pan American Highway system to provide all-weather, all-year travel. This is, of course, particularly true of sections where the right of way is still impassable.

Bridge construction "south of the border" has, in the last two decades, been much along the same lines followed earlier in the United States. Before 1900, our principal demand for such structures was in connection with the building of railroad systems. At the turn of the century there was need for spans of increased strength and clearance in keeping with the increasing size, weight, and speed of trains. But the rapid development of automobile traffic in the United States about 1915 created a demand for

TWO LARGE STRUCTURES

The 480-foot bridge across the Rio Goascoran (right) between El Salvador and Honduras consists of a 220-foot center span and two end spans of 130 feet each. The deck is 28 feet wide and has two 2-foot walkways. Below is the Tamasulpa River bridge in Guatemala.

more and better roads and, later still, for express highways. This called for a number of large bridges over waterways that had previously not been spanned.

It was the beginning of the Pan American Highway in 1930 that gave impetus to the construction of both international and other bridges within the national boundaries of the other Americas. The new structures are modern in design, strategically located, vital to the economic life of the republics, and important to international communication both in war and in peacetime. They contrast sharply with older spans that are still in use, such as the Puente Esclavos (Slaves Bridge) in southern Guatemala and on the route of the Pan American Highway. This stone arch structure, which was built with slave labor around 1592 and reconstructed in the early seventeenth century, is wide enough for only 1-lane traffic. One also comes across old bridges similar to those in other lands. Some in the interior, for instance, are like the grass-rope spans in India, except that they are more often than otherwise made of vines. They hang across chasms or arroyos.

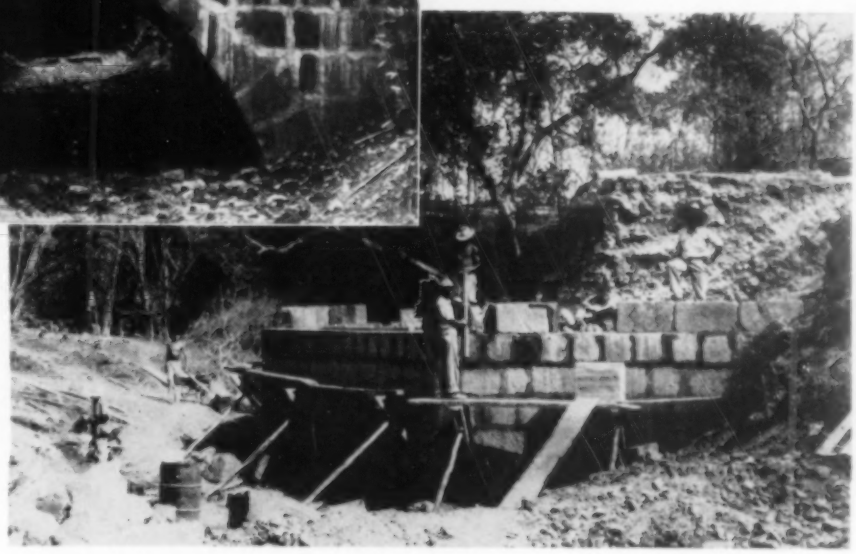
In Mexico there is a bridge that has a gateway and that is of a type built in Europe before the eighteenth century. The gateway, located either on one of the piers or at one of the approaches, had a military significance and was often flanked by a tollhouse. An interesting structure on somewhat the same lines is found about 10 miles from Mexico City on the road leading from Teotihuacan. A long causeway stands there flanked by old guardhouses which were probably intended for military use because the crossing was near the last of the overnight stops which the viceroys, sent from Spain to govern Mexico in Colonial times, had to make in the perilous journey to the capital after landing at Vera Cruz. Examples of the so-called early Roman "bridge," which is really an aqueduct, likewise can be seen in Mexico.

The most noteworthy of the modern highway bridges are those joining ten of the republics, and the Puente Cuscatlan in the interior of El Salvador. The international bridges connect bordering countries—the United States and Mexico, Mexico and Guatemala, El Salvador and Honduras, Colombia and Venezuela, Colombia and Ecuador, and Brazil and Uruguay. One now under construction across the Rio Uruguay will join Brazil and Argentina.

Of the several structures that span the United States-Mexico border, the much-traveled bridge linking Laredo and Nuevo Laredo is probably the best known because it is the beginning of the Inter-American Highway that leads to Mexico City and points south. It is 1400 feet long, carries a 24-foot traffic lane flanked by walks each 8 feet wide, and has railings that can be taken down when floods threaten.

There are two bridges between Mexico and its neighbor to the south—Guatemala. Both span the Rio Suchiate. One provides rail connection between Suchiate in Mexico and Ayutla, Guatemala, while the other—the new El Talisman—is a highway bridge which is located about 25 miles upstream. The former is the first direct overland route between the United States and Central America and was opened to service on October 1, 1942, when a heavily laden freight train was run across it. It is a creosoted-timber structure of the trestle type, is 1140 feet long, and was built under the direction of the Mexican engineer Manuel Buenadad. Work on it was accelerated by the use of prefabricated parts from the United States, and it was erected in 90 days at a cost of $80,000, financed by the National Railways of Mexico.

Suchiate is the southern terminus of the standard-gauge system of the National Railways of Mexico. Ayutla, on the southern bank of the Suchiate River, is the northern terminal point of the narrow-gauge system of the International Railways of Central America. The tracks on the new bridge are standard-gauge. South-bound merchandise reaches Ayutla in Mexican cars and is transferred from one line to the other at a 300-foot covered platform with a narrow-gauge track on one side and a standard-gauge track on the other. Before the existence of the railroad bridge, cargoes had to be transported by truck or oxcart to the river bank, ferried across the Suchiate on barges, again loaded on ox-carts, and hauled to the railroad. The distance between the two old terminal stations was nearly 3 miles, and only about 1200 tons of freight could be handled monthly. At one time there were piled up at Ayutla some 300,000 sacks of coffee awaiting shipment to the United States. Now, anywhere from 70,-



DETAILS OF CONSTRUCTION

Tufa, a rock of volcanic origin, is being used extensively for bridge construction in Nicaragua. It is soft enough to be quarried and dressed with hand tools, but the surface hardens upon exposure, and the rock has shown no deterioration after 25 years of service. These pictures show a bridge abutment and a stone arch culvert built and being built of the material.

000 to 80,000 can be moved a month.

The steel-and-concrete structure over the Rio Goascoran between El Salvador and Honduras was formally dedicated on December 15, 1943. It was built by a United States firm as a coöperative project of those two countries and the *U. S. Public Roads* Administration. One-third of the construction cost was paid by Honduras and El Salvador from loans received from the Export-Import Bank of Washington, and the remainder was provided by the United States.

Between Colombia and Venezuela is the Puente Internacional Simon Bolivar that connects San Antonio del Tachira, Venezuela, and Cucuta, Colombia. It is on the Simon Bolivar Highway—a section of the Pan American Highway system—that links Quito, Bogota, and Caracas in Ecuador, Colombia, and Venezuela, respectively. The bridge was jointly built by the Venezuelan and Colombian governments.

Colombia is connected with Ecuador by the Puente Nacional Rumichaca which crosses the border at a gorge a few miles south of the Colombian town of Ipiales. At one end Colombia has a customs station with a draw chain across the highway; arched over the road on the other side is a customhouse maintained by Ecuador. The Maua International Bridge, another link in the Pan American Highway, crosses the Rio Yuguaron and joins the town of Rio Branco in Uruguay with Juaguarao in Brazil.

Since November, 1941, work has been proceeding on a span over the Rio Uruguay between Brazil and Argentina at Paso de los Libres. The two nations will share equally in the construction and financing of the $2,250,000 project. The bridge has a total length of 4660 feet, exclusive of supplementary sections that will cross adjacent areas subject to floods, and is divided into ten spans, each 466 feet long. The roadway, including a 3.8-foot walkway, is 19.68 feet wide. The railroad lane is 12.46 feet wide.

As for the Puente Cuscatlan, which has already been mentioned, this structure has the distinction of being the longest suspension-type bridge in Central America and was built by a United States company for the Salvadoran Government. The latter paid the entire cost of $700,000. It spans the Lempa, the largest river flowing into the Pacific Ocean south of the Colorado River in the United States, and was dedicated in June of 1942.

For the construction of permanent bridges along the Inter-American Highway, the U. S. Public Roads Administration entered into a contract with the Frederick Snare Corporation of New York City. This contract covers nine permanent steel or concrete spans of which four will be located in Nicaragua, two in Costa Rica, two in Honduras, and one on the El Salvador-Honduras border. Most of these are well advanced.

Because of a scarcity of proper materials, fabricating equipment, and skilled labor, the U. S. Army Engineers, in building the pioneer road in Central America, erected 93 prefabricated-timber bridges and eight steel bridges that had been abandoned and bought in the United States. The timber structures range in length from 50 to 100 feet and are designed for 1-way traffic with a 15-foot clear roadway and for H-15 loading. The dismantled and reconditioned steel bridges have spans of from 80 to 184 feet.

The work of constructing the bridges on the pioneer road was aided by a mission sent there by the U. S. Forest Service. Specialists classified the timber that was available near the route and tests were made by the Forest Products Laboratory, which recommended basic working stresses for design purposes. Through further field investigation the engineers determined that sound straight trees were available which would furnish logs up to 80 feet in length.

The program, calling for the use of local materials as far as possible, led to the utilization in Nicaragua of tufa rock of volcanic origin for arch culverts, bridge substructures, abutments, and piers wherever deposits were located close to the building sites. On these structures native stone masons did excellent work, which is the equal in appearance of any of reinforced concrete.

Inter-American health and sanitation measures are serving to combat malaria and to deal with other problems of hygiene along nearly 14,000 miles of the Pan American Highway. The program was recommended at the Rio de Janeiro Conference of American Foreign Ministers and is being carried out in Mexico, in all of Central America, and in every republic in South America with the exception of Argentina. Thus the United States and the other Americas have merged their facilities and resources to bring about the realization of the greatest coöperative project in the history of the Western Hemisphere.

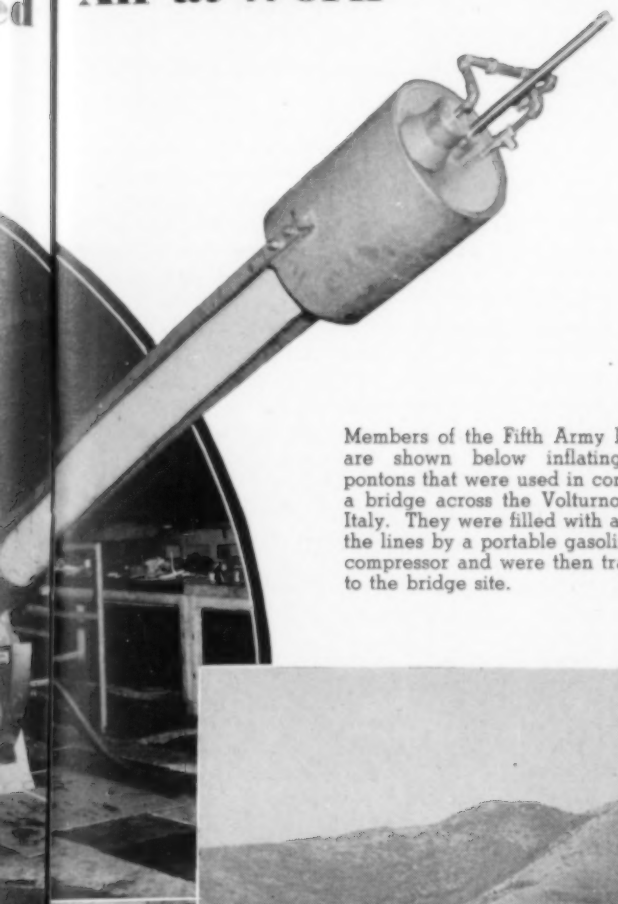
Compressed

Photo Courtesy Quartermaster Review

Compressed air has come to the aid of the Army Quartermaster Corps at Camp Edwards, Mass., by solving the vexing problem of how to repair battered canteens. Thousands of these containers were piled up awaiting reclamation, and under existing methods of dealing with them the pile was getting bigger and a great many of them were reaching the scrap heap. Then Sgt. Charles E. Anderson and Arthur Deschenes, civilian superintendent of the metal shop at the New Bedford repair shop, began experimenting with air pressure to force the dents out. They rigged up some salvaged piping, rubber hose, and gate valves, connected the line up to a receiver of an air compressor, and licked the problem in quick order. The picture above shows one of the four working stations of a bench where 500 canteens are now reconditioned every day. A canteen is screwed onto the end of the air line, leather and steel washers being used to make a tight connection. Air is admitted by opening two gate valves, and the larger dents in the canteen instantly disappear. With the canteen resting in a half-mold, the workman taps out the smaller dents with a metal-pounder's hammer. A pressure of 180 pounds was first tried, but as this was sufficient to rupture an occasional canteen it was reduced to 140 pounds. If a canteen has holes in it, or is split, it is soldered and then reformed by the pressure method. Within nine months after the idea was introduced less than a bushel of canteens became scrap.

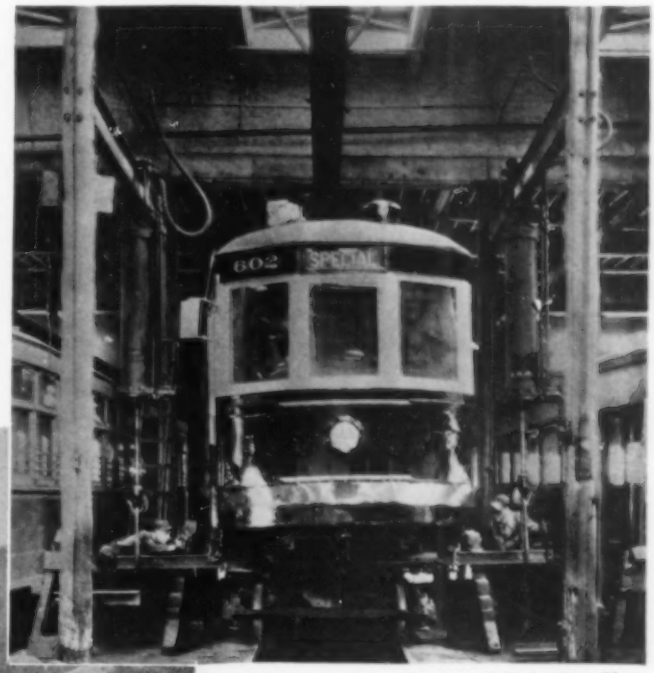
Air at Work

Photo from Automotive Council for War Production



One of the nation's automobile factories that has a contract for building 5-inch naval guns tests them (left) without firing them. Instead of powder, compressed air is used. To eliminate the need of providing an outdoor proving ground and of moving each completed rifle to it for testing, the automotive engineers designed and built an air-operated mechanism that simulates actual conditions. The guns are "fired" inside the factory walls, and the Navy has accepted hundreds of them for service on destroyers and merchant ships. To speed up production, the manufacturing operations are divided among four automotive plants, while a fifth does the machining, assembling, and testing.

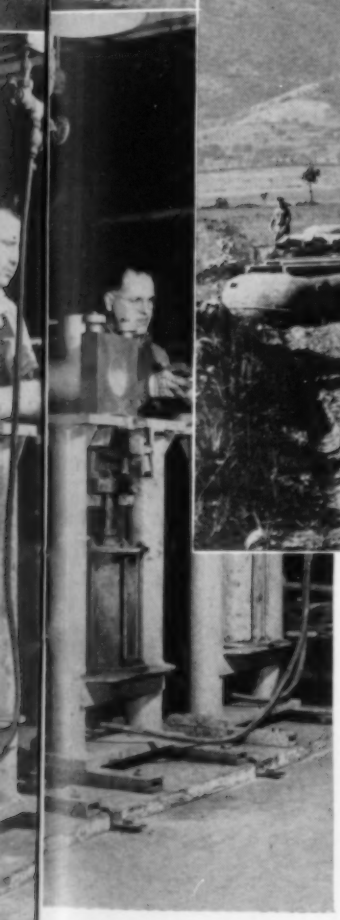
Members of the Fifth Army Engineers are shown below inflating rubber pontons that were used in constructing a bridge across the Volturno River in Italy. They were filled with air behind the lines by a portable gasoline-driven compressor and were then transported to the bridge site.



Compressed Air Institute Photo

Compressed air performs a triple service in connection with the maintenance of street cars in one of the nation's cities. The car shown above is lifted from its tracks by air-cylinder hoists on each side of it. While in the raised position, its driving motors are cleaned with a compressed-air jet, and the entire understructure is painted with air-operated spray guns. Air for these purposes is taken from the shop distribution system, which also supplies motive power to grinders, chippers, reamers, drills, impact wrenches, and other pneumatic tools that are used in repairing cars.

Acme Photo



Air-operated swaging machines (left) are used in the plant of the American Central Manufacturing Company, Connersville, Ind., for reducing the diameter of port extension tubes of aircraft-engine collector rings. An air cylinder exerts a direct downward pull of 5000 pounds, and a tube of 16-gauge stainless steel can be reduced in diameter as much as 0.03 inch with one impact. A foot-operated valve opens the discharge at the bottom half of the cylinder, permitting the building up of 100 pounds pressure on the top half. Cams hold the die blocks in position until they are tripped by a separate hand lever, which is included for operating safety. The stroke can be varied by adjusting the time between application of the air pressure and tripping. The machines were designed and constructed by the company's engineering department.

Care of Air-Driven Tools Used Underwater

THE article on the subaqueous uses of compressed air and pneumatic tools published in our May issue has provoked a number of questions from interested readers which we are answering here in the belief that the added information may be helpful to others.

At the Salvage School on New York City's waterfront, the course prescribed by the Navy for the students inc'udes comprehensive training in the use of many kinds of air-driven equipment because of the advantages they offer over manually operated tools in underwater work. Marine salvage, especially in time of war, calls for the utmost dispatch; and air-driven tools do the necessary work quickly and lessen the labor or stress imposed upon the diver.

Many vessels have been sunk, grounded, or otherwise disabled during the present conflict. Wherever feasible, their salvage has been undertaken either to save all or parts of them for reuse or to recover as much of their cargoes and equipment as circumstances permitted. A great measure of success has rewarded these efforts, and property representing millions of dollars has been recovered and made available for essential services, thanks to the employment of compressed air and pneumatic tools. While the first cost of these power tools is more than that of the much simpler ones designed for handwork, still the salvage experts of the Navy point out that the former are relatively inexpensive when compared with the total cost of the entire enterprise and the value of the ships and other property which they help to reclaim.

Obviously, air-driven tools used in subaqueous work must receive special care, and at the Salvage School the men are trained how to handle and to service them so that they will remain in good working order and perform efficiently as long as practicable. Like all pieces of machinery, they must be kept clean and properly lubricated to protect them against the corrosive action of water or moisture and the abrasive or eroding action of sand, silt, or other solids in suspension. The Navy's salvage operations have been carried on in regions where temperatures have varied all the way from intense cold to tropic heat, and the waters in which the tools have worked have therefore imposed a wide range of tests, especially in the matter of lubrication. The naval divers have profited by this experience.

In the preceding article it was mentioned that it is the practice in the case of the Multi-Vane or rotor-driven type of air tool to fit a nonreturn or check valve over the exhaust. This is done to prevent or to minimize the leakage of water into the tool and especially to obviate rusting of the air motor that would be apt to impair its function more or less rapidly. The check valve has justified its use, particularly when the tools have had to operate in water fouled by sewage or carrying sand or silt.

Multi-Vane tools, as is well known, are equipped with gears to reduce the high speeds of their rotors to the much lower speeds required for the work for which the tools are designed. The chamber in which the gears are housed is filled with grease both to protect and uniformly to lubricate them. When the tools are used in cold water, the low temperatures tend to stiffen the grease and to impair its function as a lubricant. Under such conditions it is customary in the naval service to open the gear case at short intervals and to inject into it a small quantity of light oil (I-R No. 10) which was developed to resist the action of low temperatures. The application of the light oil neutralizes any increase in the viscosity of the grease induced by chilling.

The practice among naval salvage divers is to send tools of this particular drive to the repair room at the end of each shift of underwater work. There they are run for a short period to expel any water that may have leaked in, and all the while lubricating oil is fed into them with the motive air just as is done while they are in action submerged. Emphasis is laid on the economy of proper and ample lubrication at all times, and this applies especially to the tools when used subaqueously. There is a fairly numerous family of tools with air-motor drive that may be advantageously treated in the foregoing manner.

Clay diggers, Jackhamers, chipping hammers, and kindred air-operated tools can be employed day in and day out for two or three weeks without any internal oiling save air-line lubrication. By this method the oil is fed as needed from a lubricator connected above water in the air line and accessible to a surface attendant familiar with the requirements of such tools when working subaqueously. Tools in this group are regularly run for a short while to expel water from them after they have been brought up to the surface. Then they are cleaned externally and are again ready for underwater duty. At the end of two or three weeks, however, they are dismantled, thoroughly cleaned inside, oiled, reassembled, and perhaps run a little while for check-up. After that they are put to work again immediately, or are placed in storage for instant reissue.

In the repair shop of the Salvage School the students become thoroughly familiar with all the air-driven equipment used by them—how to take them apart, how to repair them, and otherwise to keep them in service condition. This knowledge has paid handsomely. It may be worth mentioning that the salvage division of the Navy has found that the expenditure for spare parts is considerably lower and the length of life of pneumatic tools longer than is commonly the case with the same equipment used above water. The explanation for this, in part, is that the water cools the tools when operating submerged—prevents overheating and its ill effects. But, undoubtedly, much of the sustained excellent performance must be credited to careful and continuous lubrication when the tools are in service. Then, too, the specially trained personnel is more mindful of them than is the average worker, and in this the Navy sets an example that may well be followed by others.

The assertion has been made that certain pneumatic tools, such as impact wrenches, cannot be used when there is any difficulty in supplying an "old man" or holding post for the machine. This does not apply to naval salvage operations. There the men are expected to do a successful job and to improvise from the materials available any rig that will help a tool to do its work. Brackets or lugs may be welded underwater to the plating or steelwork of a ship as a preliminary in providing a supporting or holding attachment for the tool so that the diver can drill, ream, or tap, as occasion may demand.

Some people have the notion that air-driven tools are running while they are being lowered so as to keep the water from getting into them. This is not the fact, and for excellent reasons. Where a diver is engaged in water made virtually opaque by silt in suspension, or where visibility is hampered for any reason, it would imperil him to lower a tool to him while it is running. It might swing against him and stun him before he could see it and grasp it, or it might tear his diving dress and lead to his drowning or inflict a serious injury. The risks are increased if a current of sufficient force causes the suspended tool to swing back and forth during its descent. Therefore, the tools are always lowered "dead," and where their make-up is such as to permit water to work its way into them while idle, the water is quickly forced out when compressed air is admitted. In the case of Multi-Vane tools, the nonreturn valve on the exhaust keeps the water out.

There is nothing difficult about conditions under which pneumatic tools must operate in subaqueous work nor about their maintenance. However, submerged application does entail a measure of special care which, once that fact is understood, can be easily exercised by the operator.

Photos, Fish & Wildlife Service.

Killer of the Mesa

Carey Holbrook

COYOTES AND THEIR PREY

The snarling, sharp-toothed killer in the center had to pose for his picture because he had one foot in a steel trap. At the bottom are captive coyote pups fighting over a piece of meat. The remains of a yearling cow killed by coyotes near Lucy, N. Mex., are shown at the top.

COYOTES do more than $1,000,000 damage every year to the sheep industry in the state of New Mexico alone, says Floyd W. Lee, President of the New Mexico Wool Growers Association, and he ought to know. But this is not the total loss in dollars and cents by any means, according to Louis H. Laney, district agent for the Fish and Wildlife Service, Division of Predatory Animal Control, who is given to mild outbursts of hells and damns when that killer is mentioned. Mr. Laney also ought to know, for he is in charge of 31 hunters who are engaged in fighting predatory animals, the chief of which is the wily coyote.

The hunters are full-time employees and cover the whole state, each being assigned to a given district. They are trained men recruited from the ranks of private trappers, ranchers, outdoor men who like that kind of life, college boys, as well as farmers, and are hard-working, tough hombres who can take care of themselves on the mesa or the mountains wherever coyotes or bobcats lurk. They go after their prey with anything they think will do the job, and are perfectly willing to get him in a corner and knock him on the head with a club, if necessary.

The Fish and Wildlife Service hunter often establishes camp right in the middle of his district and from there plans and carries out his campaign. The foe he is fighting is a tricky one, and frequently months are spent in tracking down one intelligent and bloody killer. In one section, a coyote roamed the range from early in the year until September, defying the efforts of the hunter, ranchers, and amateurs to get rid of him. This one animal destroyed each month throughout that period sheep and lambs to the value of $200 to $400, and was finally run down with a pack of hounds. There are many such cases, giving the professional hunter plenty of hard work to do. That they get it done is evidenced by their reports for 1943 during which they accounted for 6824 coyotes in one way or another. In addition, ranchers and stock raisers coöperating in the job of eradication disposed of 3721. Now 10,545 dead coyotes is a lot of vermin in any man's language, but even with these unbelievable figures staring him in his snarling face he continues to flourish and to take his toll of livestock right under the noses of those bent on exterminating his kind.

Originally, the coyote was supposed to be a prairie wolf, living only in the wide, open spaces. As a matter of fact he still thrives there, but he has widened his domain until it reaches from desert sands to mountain snows, and from pinewoods to seashore. The reason why this beast can live and multiply where other wild life perishes may be his hardiness and because he thrives on such a wide variety of food. He will eat the flesh of any and every animal, which he is perfectly willing to kill if he can, or devour after it has become carrion. He will eat birds, their young, and their eggs, as well as fish, lizards, snakes, insects, cactus fruit, grapes, apples, prunes, and many kinds of berries. He is destructive to barnyard fowl and goats, but his one big weakness is sheep or lamb flesh, and it is in this field that he causes the greatest havoc.

The actual damage done to sheep is not confined to those destroyed for food, but is probably more than doubled by

wanton killing and by the harrassing of flocks. Frank C. Clark, past president of the California Wool Growers Association, relates an instance where he took a fat, grown coyote fresh from the kill of a large lamb. The lower end of the beast's gorged stomach revealed meat, skin, and the red hair of a hog. The nearest hogs were upwards of 10 miles away. At that time Mr. Clark kept his flock within the confines of a heavy, 6-foot picket fence, supplemented by eternal vigilance. Examination showed that coyotes had gained access not only by gnawing their way through the fence but also by scaling it despite the three or four barbwires strung around the top of it. They made continued attacks, even in summertime when the surrounding cattle ranges were infested with ground squirrels, other rodents, and game.

Aside from the loss in dollars and cents through these depredations, there is the serious danger, especially in districts where the creatures have been allowed to increase, of an outbreak of rabies among them. Within the last two years one such epidemic in three or four counties in the southern part of New Mexico brought on a condition that compelled the U.S. Public Health Service to quarantine the area. More than twenty persons were bitten either by rabid coyotes or by domestic animals that had been infected by them and were given the Pasteur treatment. The outbreak was traced to an influx of rabid coyotes from Mexico where control of the pest was lax. The Fish and Wildlife Service sent a force of twelve hunters into the district, and they began working from the outside edge of the territory affected, thus closing in on their quarry. Within two months more than 600 were killed, many of them known to be rabid.

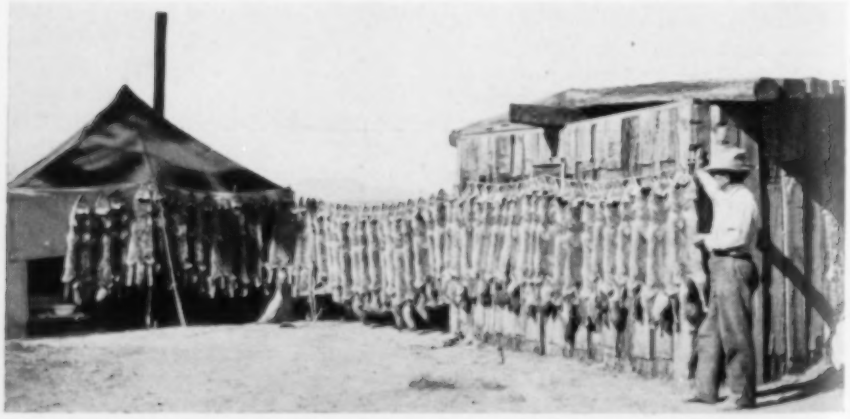
In New Mexico, the fight against the coyote is carried on coöperatively by the U. S. Fish and Wildlife Service, by the State of New Mexico and some of its counties, and by many ranchers and stock raisers. This combined army wages war against the marauder in every conceivable way, including the use of large quantities of poison, steel traps, as well as guns and dogs. But the most modern means of coyote hunting is the airplane, which has been adopted by a group of ranchers north and west of Pecos. In that section the menace became so serious that ten big ranchers, owning about 1,000 sections of land, formed what is known as the Kent Airplane Company. A plane was purchased, and L. P. McCasland, an experienced pilot of Barstow, Calif., was hired to help conduct an intensive strafing campaign against the foe. With the ship flying only about 25 feet above the ground, the coyotes are killed with a shotgun. Cowboys on horses range the brush and scare the animals out into the open. Then a rancher, riding with the pilot as a passenger, knocks him off with a splatter gun.

The estimated damage done by coyotes in the area in question is far in excess of the cost of the plane and its pilot, and the men figure they have made a good investment. However, the sport is not considered the safest in the world. In making their contract with McCasland, the ranchers decided it would be good business to protect themselves with an insurance policy on their man, but found that no domestic company would take the risk. A London firm finally agreed to take a chance in consideration for a nice fat premium. Compared with dodging bombs, Londoners probably look on this as safe going.

The coyote breeds once a year, and the average number of pups to a litter is from four to seven. There are instances of much larger litters, but it is safe to say that the annual increase is from 300 to 400 per cent. Coyote dens are made in the ground. Sometimes the old mother takes possession of a hole dug by a prairie dog or badger, but usually she does the job herself, rounding out a nice snug nest in which to raise her young.

The principal means of extermination are traps and poison. In New Mexico, a No. 3 steel trap is generally used and is placed under dirt near a clump of grass, a bush, or wherever the coyote is liable to walk into it. To attract his attention it is baited with a piece of fish, rotten meat, or other strong-scented lure. In the case of poison, strychnine, made up into "pills," is the usual dose. These are concealed in chunks of fat or tallow that are scattered around a carcass where the coyote will pick them up. Poison is seldom put inside for the reason that it will remain there until the carcass has disintegrated and might cause the death of valuable hunting dogs. As it is, the hunter can pick up any uneaten pieces, or, as the latter are relatively small, the hot sun will melt them in a short time and the poison, soaking into ground, will become harmless.

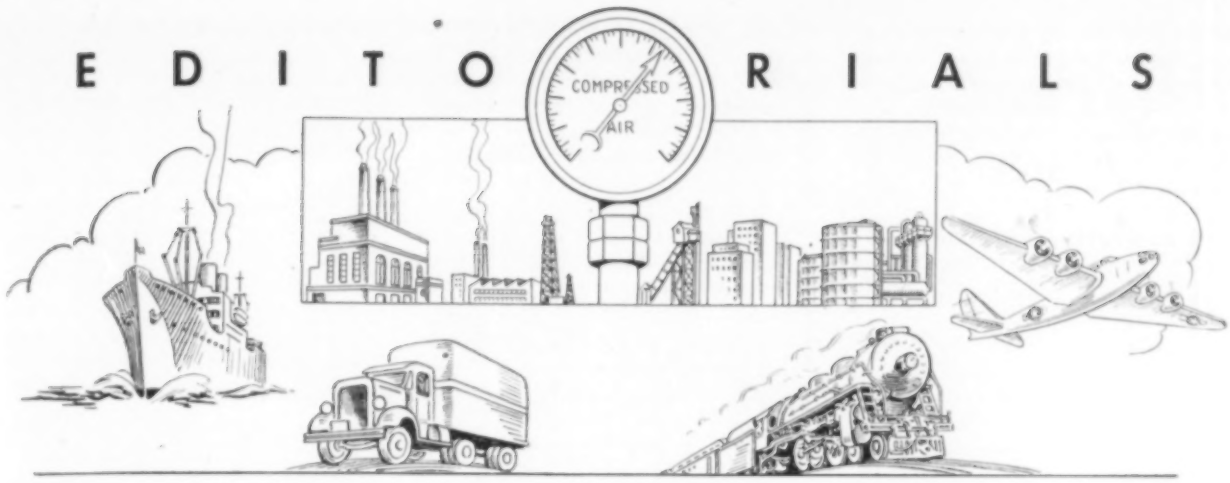
The cost of holding coyotes at bay runs into a good many dollars annually, but the investment is well justified considering the amount of damage done by these marauders. Part of the expense of eradication is recovered through the sale of hides by the agencies coöperating in the predatory-animal control. In New Mexico is held monthly an auction where sealed bids are received from buyers who have been allowed to inspect the skins, which go to the highest bidder. Those obtained by the Federal hunters are sold in the same way, only the monthly auction is held by the Seattle Fur Exchange to which the New Mexico hides are shipped for disposal. Last year the New Mexico agencies that are engaged in the work of hunting down the killer marketed coyote skins valued at more than $15,000.



BAGGED BY HUNTERS

Poison terminated the depredations of the three coyotes shown above. All were killed within a quarter-mile radius. The skins of 46 coyotes and four bobcats (right) are evidence of the work done by J. A. Young, a government hunter. The pelts are sold at established auction points.

EDITORIALS



CLEAN AIR WORKS BEST

FROM time to time we have called attention here to the wisdom of supplying clean, dry compressed air for industrial services. The increasing use of pneumatic tools and equipment in the production of war goods, and the stepping up of daily work schedules to two and three shifts, have accentuated the problem of keeping the air supply free from contaminating substances. In most applications, moisture, oil, dirt, scale, etc., reduce output and add to the operating expense. Some of the detrimental materials can be removed by passing the air through aftercoolers as soon as it is compressed, and this treatment suffices for some purposes. For many applications, however, it is advisable that there be interposed in the distribution lines additional cleaning equipment, of which there are many types on the market.

Although these facts are well known to many managements, others are either not aware of them or ignore them. For example, one maker of an approved air-cleaning device reports that he has completely equipped all but one of a number of factories maintained by a leading builder of airplanes. The results have been good; yet, for some reason, the remaining plant hasn't decided to adopt similar apparatus. Another strange fact recounted by this accessory manufacturer is that while metal mines as a whole use little air-purifying equipment, the largest piece the firm ever sold went to a mining company. Still another point puzzling this concern is why it has never installed one of its devices in Portland, Oreg., a city where the average humidity is high.

Oftentimes, production problems vanish with the drying and cleaning of the air supply. There was the case of a large Chicago newspaper that was having difficulty with moisture and oil in air that operated a pneumatic attachment on a folding machine. When apparatus for the removal of these and other contaminants were placed in the air lines throughout the plant the trouble ceased immediately, and artists working with air brushes, engravers that needed air in one step of their operations—in fact, every department that used compressed air reported better performance.

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IRON-RANGE CENTENARY

THE discovery of the first of the Lake Superior iron ranges, an event of transcending importance to the industrial growth of the nation, was made just 100 years ago. The existence of iron deposits there was mentioned in a letter written in 1840 by Douglass Houghton, Michigan's first state geologist; but he did not consider them of value, as his investigations were confined principally to the shores of the lake. The real discovery was made in 1844 by William A. Burt, the leader of a surveying party. When his compass needle behaved irregularly, he reasoned that there were iron ores nearby, and a search revealed several outcrops.

The first mine opened was the Jackson, situated on an ore body to which an Indian guide named Manjekijik led S.T. Carr on July 23, 1845. According to T.A. Rickard's *A History of American Mining*, most of the eleven organizers of the venture lived in Jackson, Mich., and each of them obtained a permit from Washington to locate a square mile of land on the south shore of Lake Superior at a cost of $2.50 an acre. These deposits were a part of the Marquette Range.

Initial efforts to smelt the ore failed, but in 1846 a man named Olds produced the first bar of iron in a blacksmith's fire. In 1848 bar iron was made from blooms and was used in building the steamship *Ocean*. The first Lake Superior ore smelted with Pennsylvania coal was a shipment of 5 tons in 1850 to an ironworks at Newcastle. Regular deliveries began in 1854, and many millions of tons have since been processed in Pennsylvania blast furnaces. A blast furnace using charcoal for fuel was built near the Jackson Mine in 1858, but the discovery of Pennsylvania coking coal sealed the doom of charcoal furnaces and was the determining factor in the transportation of lake ores southward for smelting.

The Menominee Range was the next to be exploited. Shipments from there were started in 1877, and from the Gogebic and Vermillion ranges in 1884. The Mesabi, greatest of them all, began shipping in 1892, and it was then freely predicted that Lake Superior ore would never be exhausted. The Cuyuna Range entered the list of shippers in 1911 and further strengthened this belief. Now, with a total production of 2,000,000,000 tons, experts say that the better-grade ore will be substantially mined out within twenty years, so far as open-pit operations are concerned. If the war is prolonged, even this estimate will have to be lowered. Hereafter, more and more ore will come from underground, although there are millions of tons of comparatively low-grade deposits that lend themselves to open-pit production. Extensive concentrating facilities would have to be provided to enrich them.

To separate the Mesabi ore from the hard, fine-grained taconite in which it exists, it is necessary to crush the material to −100 mesh. The ore must then be concentrated by one of several available processes, and the concentrate must be agglomerated to fit it for blast-furnace use. Experts say that equipment to produce 30,000,000 tons annually would cost $100,000,000 and would require 15,000 men for its operation.

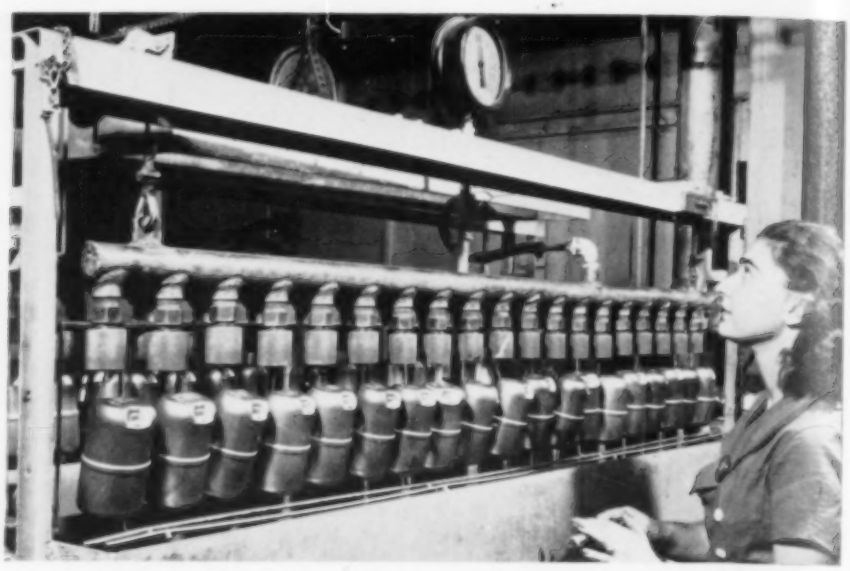
The hundredth anniversary of Lake Superior iron will not slip by entirely unnoticed by the steel industry that it has served so well. The Inland Steel Company is restoring the old Greenwood charcoal furnace near Ishpeming, Mich., as a matter of sentiment. It ran only ten years and has been idle since 1865. Although it will be rehabilitated so that enough iron can be turned out to mark the anniversary, no effort will be made to keep it in production.

"Bug Bombs" Protect Soldiers' Health

SMALL metal containers charged with a powerful insecticide and high-pressure Freon gas are used by our armed forces in tropical areas to kill mosquitoes, flies, and similar disease-spreading pests. When a soldier wants to rid his tent of vermin, he unscrews a cap from a needle-size tube extending down into the container or "bug bomb." Propelled by the gas, the insecticide issues in the form of a spray, and enough of it is discharged in three seconds to kill all the insects in a pup tent. Each dispenser contains one pound of insecticide, sufficient for 12 to 14 minutes of spraying, or for the eradication of the insect life in 240 pup tents or 50 large bombing planes.

The insecticide, which is called aerosol, is a mixture of pyrethrum and sesame oil. It was formulated by the U.S. Department of Agriculture and is harmless to humans. The container was developed by engineers of the Westinghouse Electric & Manufacturing Company and is thrown away when empty. Its designers were faced with the problem of providing something inexpensive and light but at the same time strong enough to withstand up to 2000 pounds pressure per square inch. They succeeded by making it of metal 44/1000 inch thick and by brazing to it a cloverleaf-shaped rupture disk that serves as a safety valve. If a dispenser is subjected to great heat—as may happen in a ship's hold—the internal pressure will build up to as much as 700 pounds. Under such a condition the rupture disk will function and permit the gas to escape slowly, thus averting the danger of an explosion.

Up to March 1 more than 7,000,000 bug bombs have been shipped to the fighting areas. Collectively, they would kill the insects in 70,000,000 homes, which is nearly twice the number in the United States. The expectations are that they will become generally available after the war for insect control in homes and farm buildings. It is also possible that they may be converted into spray guns by substituting thin paints or lacquers for the insecticide and used for coating furniture, automobiles, etc.



TESTING THE CONTAINERS

The worker is charging the "bug bombs" with air at 200 pounds pressure preparatory to immersing them in water in the tank below and looking for tell-tale bubbles that indicate leaks. The tank bottom is lined with mirrors to aid in detecting leaks on the undersurfaces of the containers.

SHE TRIES TO BREAK LENSES

An American Optical Company inspector tests the toughness of safety-goggle lenses by deliberately attempting to smash them. Through the pipe at the right a 5/8-inch steel ball weighing a little more than 1/2 ounce is dropped on each lens from a height of 6 feet. The lenses must survive this test to be used in goggles worn by industrial workers exposed to eye hazards.

Metals in Surgery

METALS at the battle fronts are not only inflicting damage to our fighting men but also helping to repair it on an increasing scale, according to a recent announcement of the Fansteel Metallurgical Corporation. The materials used for the latter purpose must be nontoxic, a requirement that is fully met by tantalum which, in addition, is unique in that bone and soft tissue will grow over it and adhere to it. These qualities make it suitable for mending bone and skull fractures and nerve and tendon injuries.

Major skull surgery has been performed with tantalum implants that cover more than the forehead, and the men so "patched up" have been returned relatively quickly to active duty. Plates of the same metal are being nailed to badly fractured bones to reinforce them, and joints that have become separated are being drawn together with tantalum bolts. In the case of severed nerves, tantalum wire is sutured to the ends and tantalum foil is wound around the area to prevent the frayed nerves from adhering to the surrounding tissue.

On the home front, M. N. Smith-Peterson, chief orthopedic surgeon at Massachusetts General Hospital and inventor of the nail for repairing broken hips, is using an alloy known as Vitallium in arthritic surgery. The metal is composed of 65 percent cobalt, 30 percent chromium, and 5 percent molybdenum, and has served dentists for some years in making dentures and bridgework. By means of a thin layer of this alloy, Dr. Smith-Peterson caps the heads of thigh bones that can no longer move freely in their sockets because the smooth cartilage that lines the latter has been destroyed. The artificial cartilage prevents the bones and sockets from growing together and gives them mobility. The same thing has been done for finger joints that have become stiff through arthritis.

Factory Installs Radiant Heating System

A CONTRAST in heating systems is offered by the Murray Corporation plant in Towson, Md., where a single stoker-fired boiler supplies hot water for radiators in the office building, unit heaters in an old part of the factory, and a radiant heating system in a 60x80-foot addition. The latter system consists of 2360 feet of 1¼-inch wrought-iron pipe assembled in three banks of grid coils. These are laid on strips of 1-inch Celotex, 8 inches wide, resting on a bed of crushed stone 6 inches deep and topped with a course of concrete 6 inches thick.

It is reported that the floor coils not only carry the entire heating load for the annex but that the design flow temperatures had to be reduced from 110 to 98°F. in order to lower the floor temperature from 85 to 75° so as to provide an air temperature of around 65°. In the course of an inspection trip made on a day when a strong wind was blowing and the thermometer registered 10° above zero, the office was stuffy at 75°; the old section of the plant was drafty and cold at 70°; and the new building, with a warm floor and no drafts, was comfortable at 65½°. A comparative report for the past heating season, during which unusually cold weather was experienced, shows that the radiant heating system gave the most satisfaction.

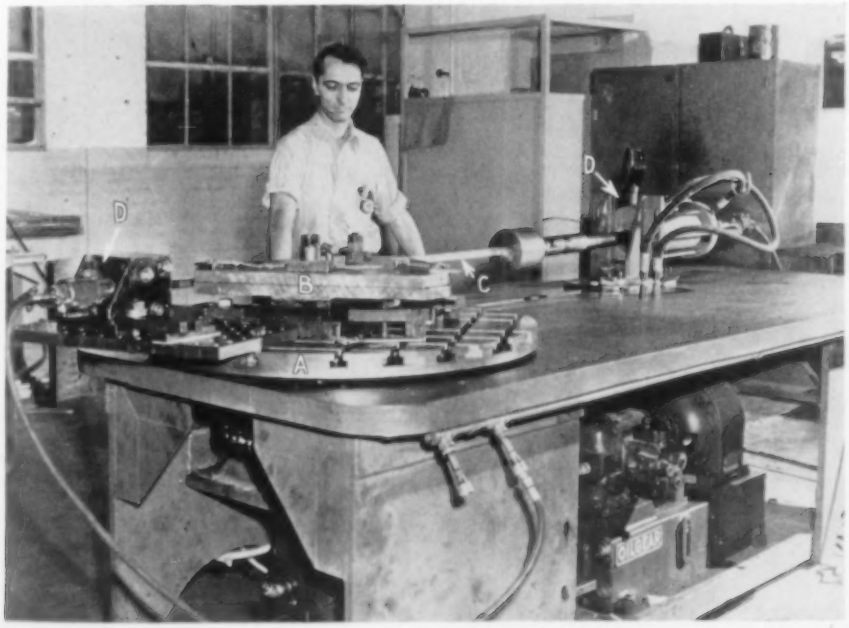
FLOOR SECTION

Each heating coil consists of 8-foot lengths of 1¼-inch pipe laid on 18-inch centers and welded to 2-inch-diameter manifold headers. The individual pipes rest on strips of Celotex laid on a bed of crushed stone and are topped by a course of concrete 6 inches thick. Bench marks on overhead beams indicate position of piping so machinery can be installed without damaging the heating system.

Pneumatic Tubes Handle Scrap Metal

PNEUMATIC-TUBE conveyors such as are used for handling ash in powerhouses are suitable for the transfer of certain kinds of blast-furnace scrap. The disposal of chips, borings, and turnings, with the tremendous upswing in the metal-working industries, has come to be a major materials-handling problem, especially where large quantities are produced in the course of a day. That is the case in a munitions plant, which has simplified the operation by installing a pneumatic-conveyor system that delivers crushed and dried chips direct to briquetting machines.

By the new method, the scrap from the shops is delivered to a crusher, whence it drops by way of a hopper into one of two pneumatic tubes through which it is forced up into a receiver. From there the material is fed into a horizontally disposed kiln that discharges it free of cutting oils into the second pneumatic conveyor. There blower air picks it up and elevates it to any one of three hopper-type containers, depending upon the composition of the metal. Next, the dried chips pass into as many storage bins, each of which holds 40 tons. The last step in the cycle is briquetting, which is done by two machines provided with conveyors that load the finished product into dump cars. The system processes and handles cast-iron and fine grades of steel and has a capacity of 8 tons an hour.



ROTO-STRETCHER

This machine was developed by the Goodyear Aircraft Corporation for simultaneously bending and stretching metal airplane parts that were previously made in conventional metal dies. The unit has a pulling capacity of 15 tons and can produce contours up to 360°. Only 45 seconds are required for one complete cycle of the turntable *A* on which the forming die *B* is mounted. The table is rotated in either direction by a hydraulic cylinder through a continuous chain and sprockets. The picture shows the beginning of a shaping operation with the stock material, *C*, clamped firmly in pneumatic jaws, *D*. So held, parts up to a maximum length of 72 inches may be handled. Different clamping arrangements permit forming sections of unlimited length.

Safe Blast-Furnace Tapping

BEFORE iron can be withdrawn from a blast furnace at the conclusion of a heat it is necessary to open up the tap hole near the bottom through which the molten iron is fed into a trough or pigs. This is done by a pointed bar or drill, and normally is a hazardous operation. To protect its workers, the Tennessee Coal, Iron & Railroad Company has introduced a safety measure in the form of a movable platform that covers the trough and serves also as a working base. The latter consists of a ¼-inch plate that is 4½ feet wide and extends back from the furnace a distance of 12 feet. It is raised and lowered by an air cylinder attached by a cable to a hook in the center of the platform and suspended from a jib crane with a 12-foot arm. Welded at an angle close to the tap-hole end and midway of the platform is a 4-inch pipe through which the drill is inserted, and a hinged gate is provided that can be closed to a snug fit around the drill shank. A 3x4-inch angle iron at the outer end of the platform closes the opening between the latter and the splasher plate. By this arrangement there is no danger from flames and sparks in case of a break through to the molten metal when drilling because they are confined within the limits of the platform and the trough.

Industrial Notes

To eliminate bearing failures resulting from dirt in grease, the National Industrial Products Corporation has developed a filler that is said to facilitate the loading of lubricating guns and to assure a supply of clean grease at all times. The unit, named Fillit, is wall-mounted and consists of a cylindrical reservoir from which the lubricant is forced by a pneumatic ram through a tube that is inserted into the portable gun. Air up to a maximum pressure of 150 pounds is used and applied or released by a 2-way valve within easy reach of the operator's free hand. Standard sizes have a capacity of 15 and 30 pounds.

A sound motion picture in color, entitled *Flame Facts*, is offered by Walter Kidde & Company to plant executives, foremen, fire-fighting organizations, educational groups, etc., without cost for exhibition purposes. The 16-mm. film runs for twenty minutes and shows various kinds of fires, why and how they burn, how they should be handled, and gives common errors in and tips on fire prevention. Requests should be addressed to 138-42 Cedar Street, New York 6, N. Y.

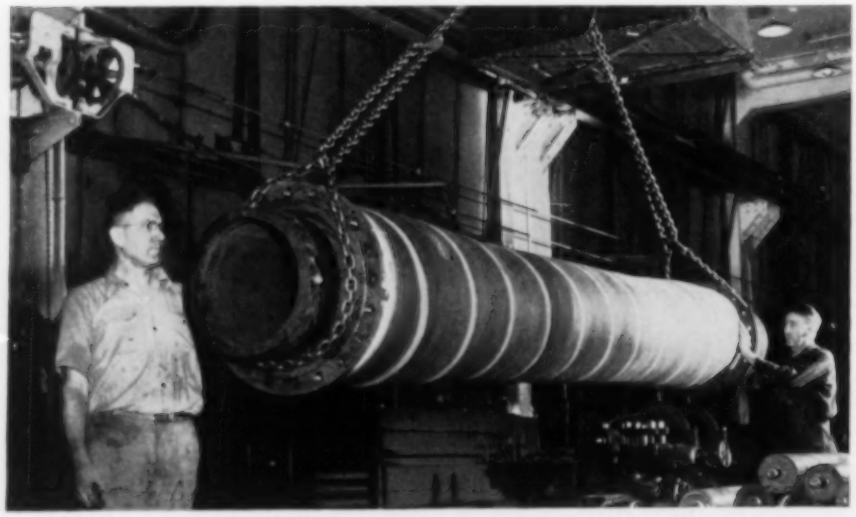
Rope that will float for from one to ten days in fresh or salt water is the object of a United Kingdom patent, according to a recent issue of *Foreign Commerce Weekly*. It is intended primarily for use as life and landing lines and, in addition to being buoyant, can be made luminous to facilitate night rescue work. Different fibers such as cotton, flax, hemp, sisal, and manila can be treated by the new process.

Sweden's State shale-oil industry has installed equipment to obtain sulphur from the gases generated in the plants. Other by-products which are being obtained in either test or commercial quantities in the process of oil extraction are: potash, ammonia, titanium, vanadium, silicon iron, and molybdenum. In its work of research, the industry is being assisted by a special committee of the Swedish Academy of Engineering Sciences.

To expedite the delivery of concrete aggregates on a western construction job that involves the pouring of large quantities of concrete, the contractor has worked out an ingenious system that enables him to change from one grade to another without loss of time. He has run his belt conveyor through a corrugated-metal conduit 84 inches in diameter and 40 feet long and has piled his aggregates adjacent to and on top of this pipe. Timber bulkheads, in the form of a zigzag, separate the different grades, each of which drops through a gate in the culvert onto the traveling belt that carries it to the central hoppers of the batching plant. A bulldozer is used to push the material up to the gates, which are said to open and close quickly without interfering with the movement of the conveyor.

A rotary, conveyor-type washing and drying machine for glass ampoules, vials, tubes, etc., has been developed by Perfektum Products Company. The unit handles containers of different shapes and sizes simultaneously and is designed for continuous or cycle operation. It is provided with eight stations, so that in its passage through the machine an ampoule may be washed with eight different solutions. At the loading end, a pneumatic feeder pushes the container over a nozzle which, as the machine rotates, registers successively with feed lines through which the cleansing fluids, steam, or compressed air are delivered with the ampoule in the inverted position. This permits the latter to drain before reaching the next station. When the belt is moving, the flow from the nozzles is automatically turned off; and in the case of liquids, the amount used may be varied by regulating the pressure with which each is applied. When it leaves the discharge end, the container is clean and dry.

In the fabrication of welded-steel bases with many transverse ribs, it was discovered in the plant of the Republic Structural Iron Works that the parts coated with a weld-spatter preventive were much easier to clean after stress-relief heat treatment than those that remained uncoated. It is now the practice there to cover the entire structure both before and after welding, with the result that cleaning time has been reduced from 3 to 1¾ hours. It is said



GIANT HOSE

This piece of flexible hose was built by The B. F. Goodrich Company and is to be used in the hydraulic mining of phosphate rock. It is made of fourteen plies of heavy duck coated with synthetic rubber and reinforced with coils of heavy wire. It weighs 2200 pounds, is 15 feet long, and large enough to accommodate a heavy-set man.

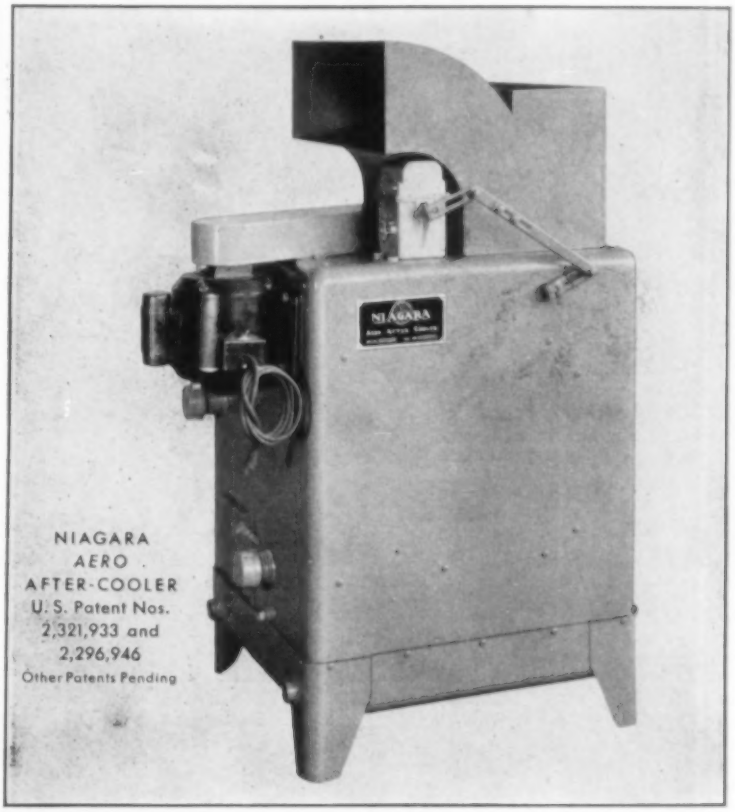
that mill scale is loose and easily removed and that the final surfaces take the primer coat better because they are smoother. The preparation used is No-Spat and is applied by air spray.

Fireblok is the name of a new refractory material produced by Johns-Manville. It comes in varying thicknesses and sizes any one of which covers much more surface than a full-sized firebrick. Four grades are available for exposed temperatures ranging from 1600 to 2600°F. and for back-up use at temperatures from 2000 to 2600°. The blocks can be cut with a saw and shaped with a rasp and, because of their size, reduce cost of installation.

Allis-Chalmers has recently announced that it carries in stock a complete line of demountable V-belt sheaves that accommodate normal shaft tolerances. Known as the Magic-Grip, it is quickly mounted or removed by the use of a tapered split bushing that locks the sheave to the shaft in one operation. The clamp fit is said to be positive and uniform and to assure wobble- and shear-free running.

An air-operated marking machine designed for either automatic or finger-tip control has been announced by Defiance Machine & Tool Company, Inc. It can be adjusted to handle all kinds of materials ranging from fibers to hardened tool steel and connected directly to a shop air line. Operation is effected through valves in the head that reverse the movement of a pneumatic piston as soon as the desired pressure has been applied and return the die to the stamping position until stopped by the operator. Marker holders are easily attached to the piston head, and three T-slots in the base plate facilitate anchoring special fixtures, where needed. Use of the portable steel cabinet is optional. It is claimed that a machine of this type has stamped as many as 4000 parts an hour.

Keeping Water and Oil Out of COMPRESSED AIR



● Controlled temperature cooling with the NIAGARA *AERO* AFTER-COOLER has been the answer to excess water and oil in compressed air lines, preventing spoilage of material when compressed air is used in process and preventing damage to pneumatic tools. No refrigeration is required.

The NIAGARA *AERO* AFTER-COOLER both condenses the moisture before it gets into the lines and also provides jacket water of the proper temperature to prevent condensation in the compressor, washing out the lubricating oil.

It helps produce compressed air containing only ½ to ¾ as much moisture as air cooled by conventional equipment. At the same time it saves 95% of the cost of cooling water, pays for itself in a short time. Write for complete information.

NIAGARA BLOWER COMPANY

"25 Years of Service in Air Engineering"

NEW YORK Address: Dept. CA-64

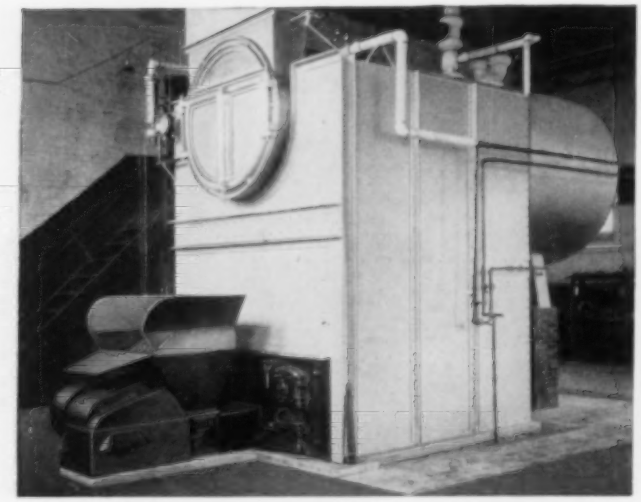
Field Engineering Offices in Principal Cities

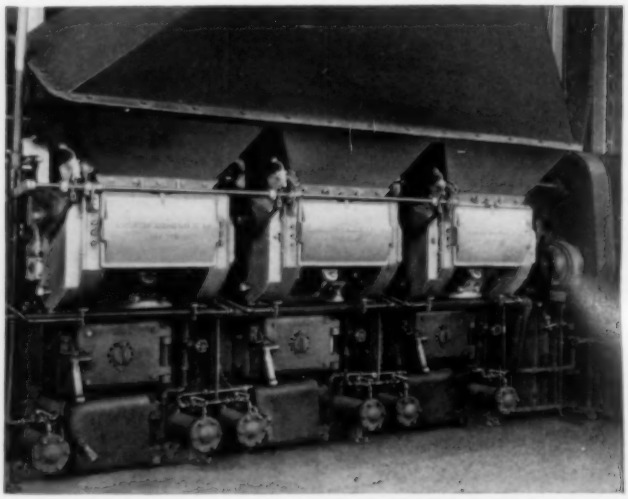
6 E. 45th Street, New York-17, N. Y.

NIAGARA

INDUSTRIAL COOLING • HEATING • DRYING HUMIDIFYING • AIR ENGINEERING EQUIPMENT

For 9 out of 10 Stoker Jobs
one of these 3 C-E types is the best answer

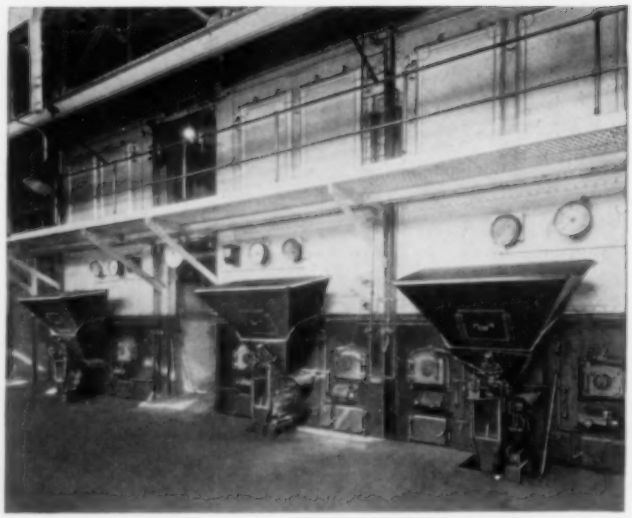




SKELLY STOKER *(upper left)* Approximate Application Range — 20 to 200 boiler hp. A compact, self-contained unit offering all the advantages of underfeed firing. Moving grate bars assure lateral distribution of fuel and maintain a clean porous fire. Cantilever dump grates of non-avalanching type simplify ash removal. Integral forced-draft fan, with vortex inlet control, permits positive regulation of air-coal ratio. Sixteen rates of coal feed through variable-speed transmission. Automatic control is standard equipment. Timken bearing equipped. Alemite lubrication throughout.

SPREADER STOKER *(upper right)* Approximate Application Range — 150 boiler hp to largest units suitable for stoker firing. A simple, rugged stoker designed to burn a wider variety of fuels than any other type of mechanical firing. Hopper, feeding and distributing mechanism, variable-speed drive and motor are combined in a compact unit. Rotating spreader blades feed coal into the furnace in crisscrossing streams which assure uniform distribution. Fines are burned in suspension and the rest of the coal is burned on a grate — either stationary or dumping type. grate surface is zoned for regulating air admission and to facilitate cleaning.

TYPE E STOKER *(lower right)* Approximate Application Range — 150 to 600 boiler hp. A single-retort, underfeed stoker designed to burn a wide variety of bituminous coals. Ram feed is supplemented by a reciprocating sliding bottom. Grate surface consists of hollow, air-cooled grate bars, alternately fixed and moving, to condition the fuel bed and assure its steady movement toward the dump trays. Air supply under zoned control with provision for introducing air over the fire. Steam or hydraulic drive.



Single Retort Underfeed and Spreader Stokers are far and away the most widely used types these days, accounting for about 90 of every 100 stokers installed under boilers rated from 50 hp up.

The high percentage of C-E Stokers selected in this category is indicative of how well these three types, described here, blanket this field.

And for the remaining 10 percent, C-E also has the right answers in its modern designs of Multiple Retort, Traveling and Chain Grate Stokers — all of them leaders in their respective fields.

So whether your plant is one of the 90 percent group or one of the 10 percent, you can turn to C-E with complete confidence that you will get the right answer for your requirements. You will also have the satisfaction of knowing that your stoker reflects the experience accumulated in installing over 18,000 stokers of all types, above residence size, to serve about 5,000,000 rated boiler horsepower. This is Combustion Engineering's record to date and no other stoker manufacturer in the country can match it. For your next stoker requirements specify C-E. A-774A

COMBUSTION ENGINEERING

200 MADISON AVENUE NEW YORK 16, N. Y.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

B. F. Goodrich grommet-type wire V belt is the first and only of its kind

New development designed for severe small-space power transmission applications

THESE drawings show the outstanding feature of the new B. F. Goodrich grommet-type wire V belt. They show the construction of the wire grommet that is responsible for the belt's performance under unusually severe operating conditions.

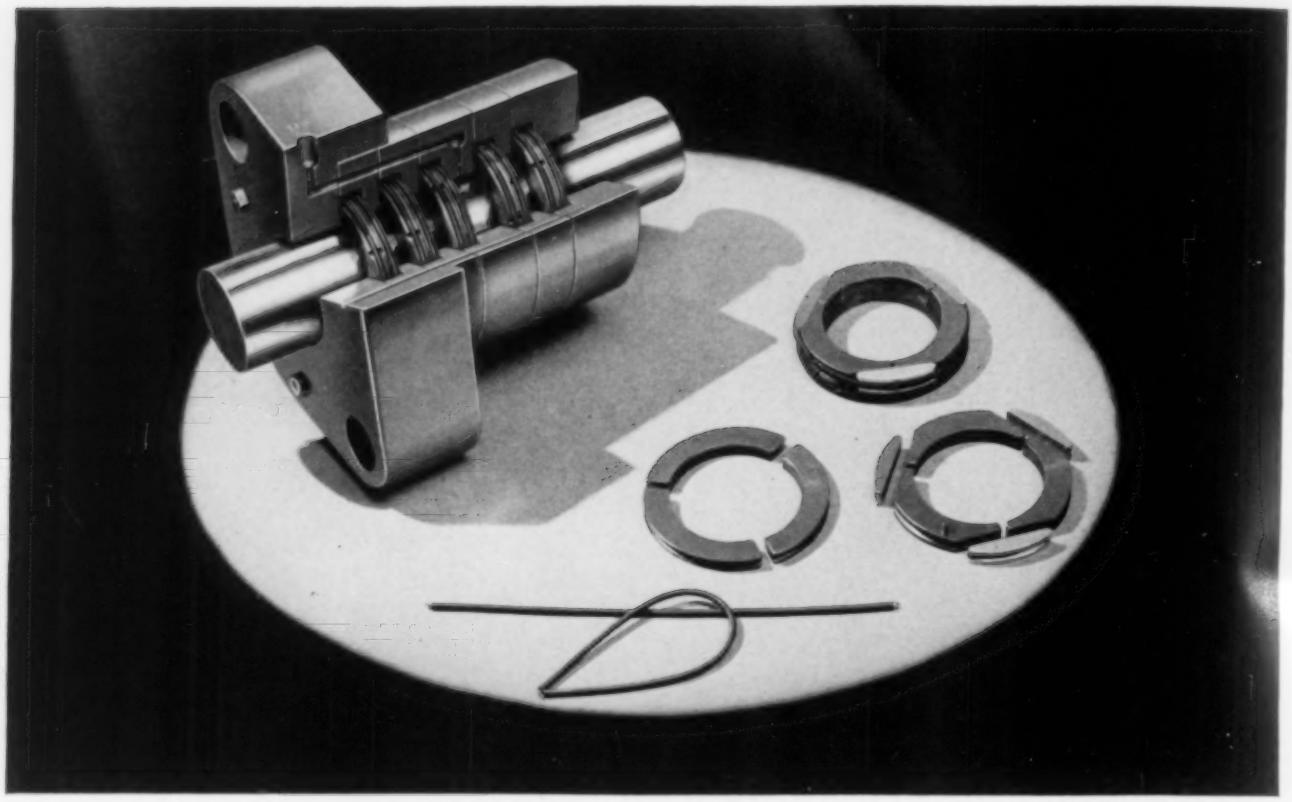
To make the grommet, the wire cable is formed into a loop, then wound spirally *on itself* up to the needed size. Then cord is wound spirally on the wire in the opposite direction to give balance to grommet and belt. The result is a truly endless wire grommet without loose ends to break out and get tangled in machinery. Stretch is to all intents eliminated.

There are many possible applications for a B. F. Goodrich grommet-type wire V belt drive. If noise and dirt are problems, noisy and dirty drives can be replaced by this revolutionary new B. F. Goodrich development. If space is limited, grommet V belt drives can usually be engineered to fit such space without sacrifice of power transmission efficiency — *and* performance and maintenance are excellent at either low or high speeds.

The B. F. Goodrich representative near you will be glad to work with you on power transmission problems. Or, for more information about the new grommet-type wire V belt, write *The B. F. Goodrich Co., Industrial Products Division, Akron, O.*

B.F. Goodrich

RUBBER *and* **SYNTHETIC** *products*



PRECISION

COMPRESSOR ROD PACKINGS

MORE HORSEPOWER AT LESS COST is the net result when your engine or compressor is equipped with COOK'S Precision Metallic Packings. Here's why:

Precision construction assures positive seal of the pressure.

Basic design allows for rod misalignment and vibration, without added friction and wear, provides automatic compensation for wear and guarantees a constant oil film between rings and rod.

Regardless of the make or type of your equipment you can have the improved operation and years of repair-free service COOK'S Precision Packings bring, because there is a proved type and material for all prevailing pressures and temperatures. Shown above is the annular cup type.

Many engine and compressor manufacturers supply COOK'S Packings as original equipment—others furnish them on request. So, when ordering new equipment, specify COOK'S Packings.

For equipment in service, write or call our nearest office.

C. LEE COOK MANUFACTURING CO., Incorporated, Louisville, Kentucky. Branch Offices and Representatives—Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, Montreal, New Orleans, New York, Portland, Ore., San Francisco, Seattle, Tulsa.

"Sealing Pressures Since 1888"

COOK'S METALLIC PACKINGS

Listen, wire rope users....

HAVE YOU TRIED TO GET TIGER BRAND...LATELY?

When America was plunged into war, we were asked to put practically our entire wire rope production at the service of Uncle Sam. For good wire rope, in enormous quantities, was urgently required for military use.

As a result, we have had to disappoint some of our customers. They were prompt to realize that it was not only a case of military necessity but to their ultimate advantage to stand aside for the time being. We are grateful for their cooperation.

Although enormous tonnages of Tiger Brand are still going to our fighting men and to our Allies, a steadily growing quantity is being made available for use here at home. So, when you need good wire rope, give us a call. The chances are becoming increasingly better that we may be able to supply you with your old favorite, American Tiger Brand—today even a better product because of its war service.

Excellay Preformed

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

COLUMBIA STEEL COMPANY
San Francisco

United States Steel Export Company, New York

UNITED STATES STEEL

For more efficient drilling

use JACKBITS

Only Ingersoll-Rand Jackbits cover a complete range of sizes from 1⅜ to 4½ inches. Included in this group are special bits, some developed for the hardest rock . . . some for abrasive or sticky ground . . . some for ground that tends to rifle or that binds the bit . . . some for ground that requires maximum bit clearance. From the many different sizes and designs, let us help you select a bit that will give you the best drilling efficiency in your rock. On one job, for example, the drilling rate increased from 16 inches to 22 inches a minute when Jackbits were put to work.

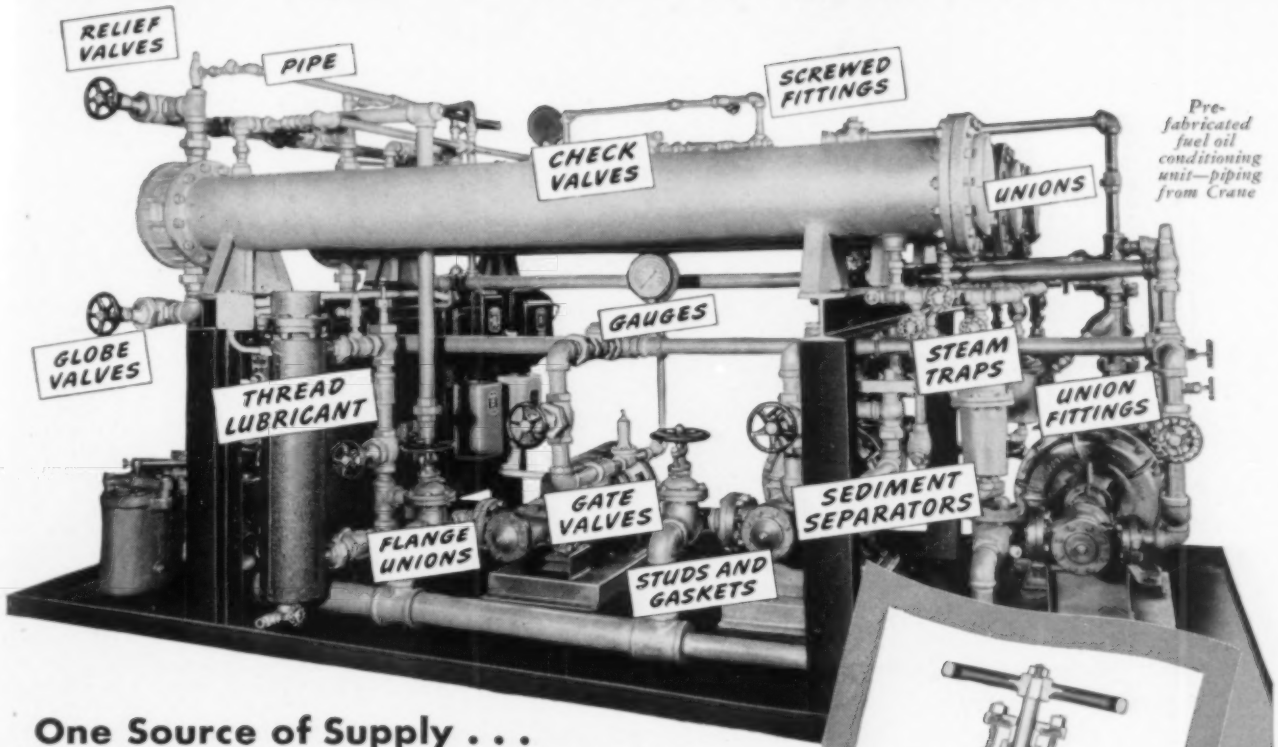
Then, too, only Jackbits are backed by a complete line of reconditioning equipment which consists of Hotmills and Grinders for resharpening bits, a Box Tool and Die Head for the easy conversion of lathes for Jackrod threading, and numerous Furnaces and Accessory Equipment. The great degree of accuracy made possible by I-R resharpening equipment permits the use of smaller-gauge bits. This leads to surprising increases in drilling speed. Yes, you will have more efficient drilling when you use Jackbits.

COMPRESSORS • TURBO-BLOWERS • ROCK-DRILLS • AIR TOOLS
CENTRIFUGAL PUMPS • CONDENSERS • OIL AND GAS ENGINES

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

JACKBITS OFFER THE WIDEST RANGE OF DESIGNS AND SIZES

Complete systems or single fittings . . . Crane meets every piping need



Pre-fabricated fuel oil conditioning unit—piping from Crane

One Source of Supply . . . One Responsibility for Materials

In buying day-to-day piping needs—or when you're planning complete new systems—the benefits of single source supply can be yours. Crane supplies everything for piping—valves, fittings, pipe, and all accessories—as indicated by the installation above. And where can you expect more complete selection than in the world's largest line of flow-control equipment for every service.

Ordering—handling parts stocks—maintenance—all these operations are simplified when you Crane equip. More important, one responsibility for quality and craftsmanship of piping materials is a primary aid to good installation. Crane meets that responsibility with 89 years of manufacturing experience.

CRANE CO., 836 S. Michigan Ave., Chicago, Ill.

STANDARD IRON BODY WEDGE GATE VALVES

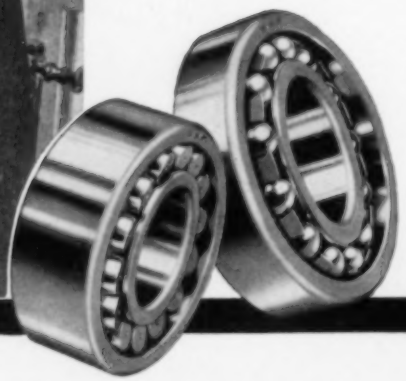
One Standard of Quality . . .

Because there is adequate quality in every part, the whole system is thoroughly dependable when it's Crane equipped. Such quality is typified by Crane Iron Body Gate Valve design: Strong body sections resist severest line strains. Straight-through ports give streamline flow. A deeper stuffing box lengthens packing life. Extra long guides keep disc travel true, while balanced stem design maintains smooth and positive operation.

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Built by
INGERSOLL-RAND
CO.



REDRESSING 250 JACKBITS P.H.

on SKF *Bearings*

More and more detachable bit users are heating their dull bits and milling the gauge and face while they are hot.

The JMA Jackmill illustrated is designed especially for this work. It redresses up to 250 dull bits per hour. The high speed cutter of this machine turns at 3450 r.p.m. It will sharpen and gauge 100,000 dull bits before it needs reconditioning.

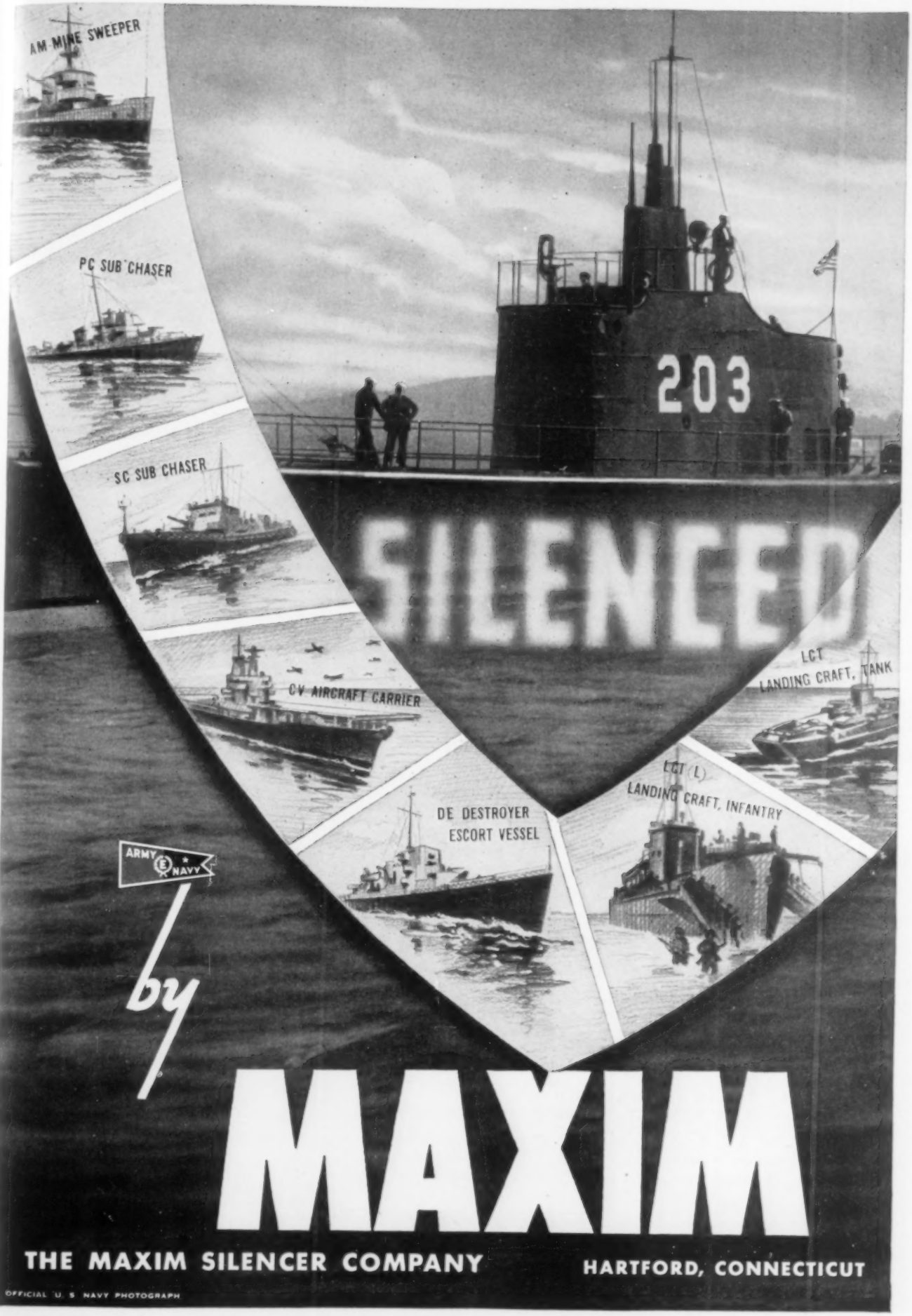
The bearing situation is well in hand. With an SKF Self-Aligning Ball Bearing on the drive end and an SKF Deep Groove Ball Bearing on the work end, shaft friction and loads are reduced. The self-aligning bearing keeps its high load carrying capacity available for useful work while the deep groove bearing accepts radial and thrust loads in any combination.

As a result of this dependability, this machine is becoming increasingly popular with mining men, quarry operators and contractors everywhere. 5574

SKF INDUSTRIES, INC., PHILA. 34, PA.

SKF

ball and roller bearings


AM MINE SWEEPER
PC SUB CHASER
SC SUB CHASER
CV AIRCRAFT CARRIER
DE DESTROYER
ESCORT VESSEL
LCT (L)
LANDING CRAFT, INFANTRY
LCT
LANDING CRAFT, TANK
203
SILENCED
ARMY
NAVY
by
MAXIM
THE MAXIM SILENCER COMPANY
HARTFORD, CONNECTICUT
OFFICIAL U. S NAVY PHOTOGRAPH

Up where the drilling begins

The economies of detachable bit drilling begin up in the grinding room—with a simple forming and gauging operation which puts a good cutting edge on the bits. But it *is* necessary to select the correct grinding wheel for the job—for instance an "Aloxite" Wheel by Carborundum—a wheel that cuts free and cool, preserving the temper of the steel.

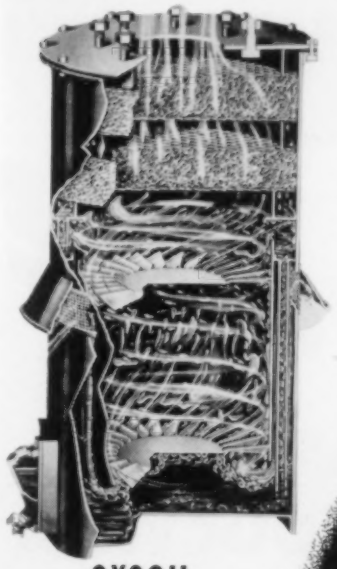
Detachable bits reduce steel shop costs and nipping charges. And in actual work they save time and labor because you don't have to take steel in and out of working spaces. So remember—the way to speed production and cut drilling costs is to keep your drills properly ground. The Carborundum Company, Niagara Falls, N. Y.

CARBORUNDUM
ABRASIVE PRODUCTS

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

Grinding Wheels by CARBORUNDUM TRADE-MARK

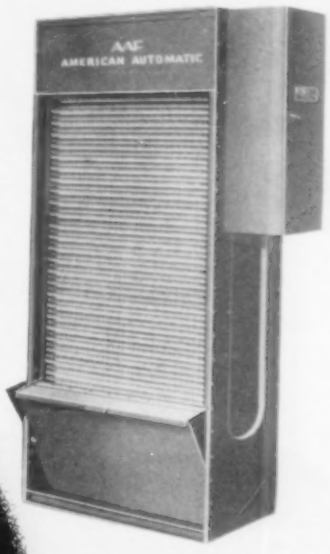
(Carborundum and Aloxite are registered trade marks of and indicate manufacture by The Carborundum Company)



CYCOIL OIL BATH AIRCLEANER

For engines and compressors subject to extremely heavy dust concentrations. Principle of operation provides four way cleaning — 1. impingement, 2. scrubbing, 3. cyclonic action, 4. filtering, thus assuring continued self-cleaning action and large dust-holding capacity. Acts as effective intake silencer as well. Write for Bulletin 130-D.

For multiple engine or compressor hook ups, multi-cylinder, and four-cycle and two-cycle engines scavenged by rotary blowers the Automatic filter is especially suitable. Practical for air volumes of 5,000 cfm or more. For detailed information on its operation and self-cleaning principle write for Bulletin 241 A.

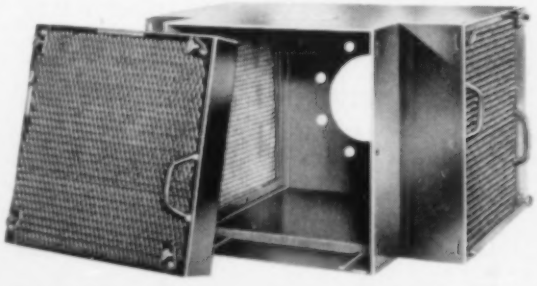


SELF-CLEANING AIR FILTER

AAF AIR CLEANER PROTECTION *Means* LONGER LIFE AND LESS REPAIR COST

Composed of complete assemblies of individual viscous impingement type cells and housings which bolt directly to flange on air intake pipe. Installed outside or inside the buildings. Sturdily built for long years of service. Recommended particularly for use in industrial districts involving normal dust concentrations. Write for Bulletin 120 D.

TYPE "OC-H" FILTER



A dry type filter employing wool felt as a filter medium. Recommended specifically for air compressors of the non-lubricated cylinder type and for engines and compressors where the intake air contains large quantities of lint, flour or other types of dust which do not suit viscous impingement type filters. Come as complete assemblies for installing on air intake pipes. Send for Bulletin 120 D.

TYPE "PL-H" FILTER

SPEED VICTORY BUY MORE BONDS

Preventive maintenance in the form of correctly engineered air intake cleaners pays big dividends. Power plants are too precious and important today to risk unnecessary shut downs and engine or compressor repairs. AAF's 23 years experience in the field of power equipment dust control is represented by a complete line of air cleaners and filters for every dust condition. Send for free engineering data and bulletins describing their installation and operation.

AMERICAN AIR FILTER CO., INC., 402 CENTRAL AVE., LOUISVILLE, KY.
In Canada: Darling Bros., Ltd., Montreal P.Q.

AMERICAN AIR FILTERS AAF

for Engine and Compressor Protection

SPEARHEAD OF THE ATTACK

THE FIRING LINE

THE FIRING AISLE

SPEARHEAD OF PRODUCTION

IN TIME OF WAR

Spearheading the tremendous production of guns, planes, tanks, and ships for our fighting forces, are the boiler room firing aisles of industry! Here, steam generating units are called on to meet extraordinary operating requirements day after day with minimum maintenance.

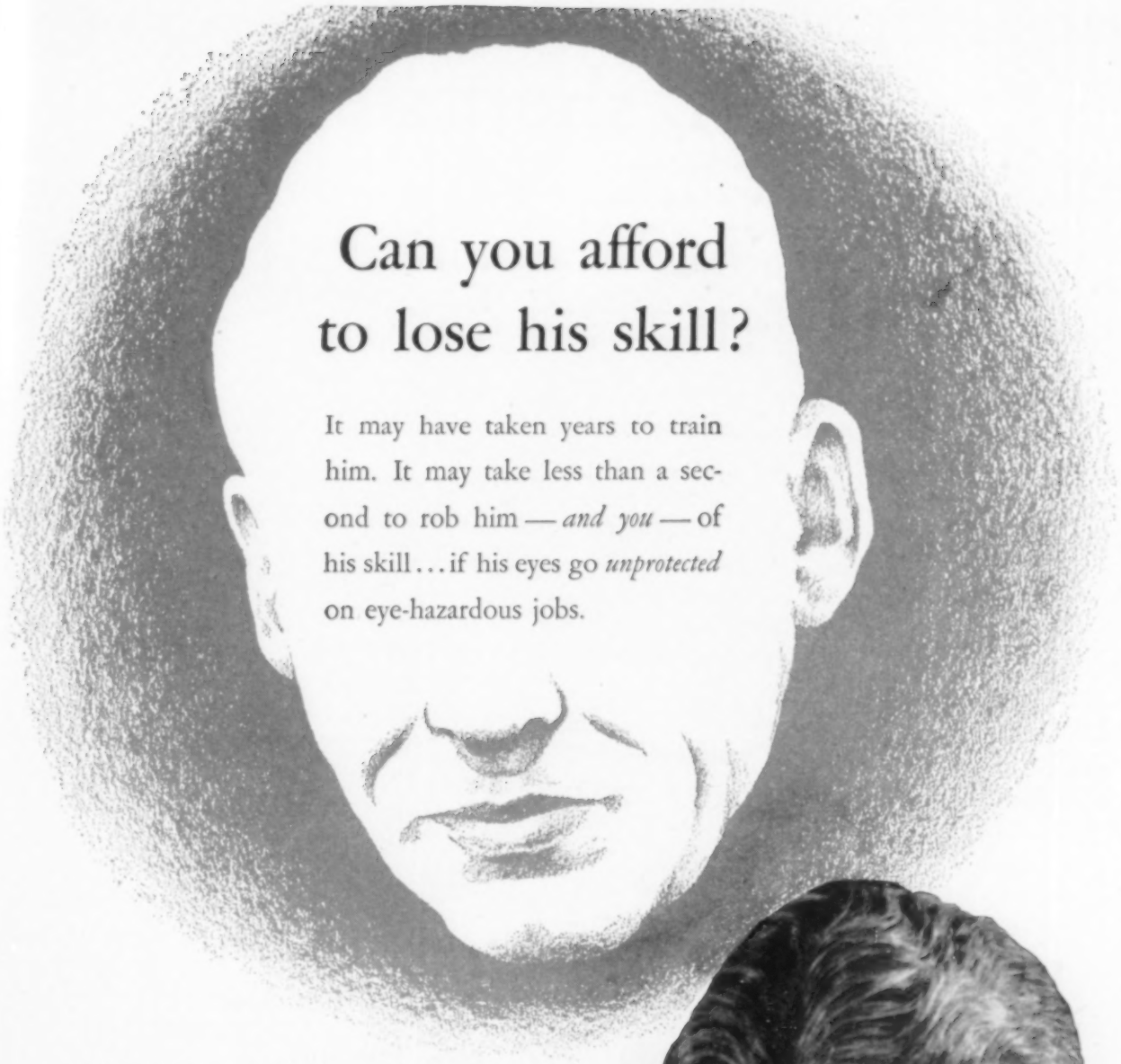
Vogt steam boilers are making outstanding records for efficient steam generation in tough war plant service throughout the Nation.

Vogt WATER TUBE **BOILERS**

Vogt builds steam generating equipment in many types and sizes to meet every power, heating or processing requirement. Bulletins are available upon request.

Branch Offices: NEW YORK CHICAGO CLEVELAND PHILADELPHIA DALLAS

HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KENTUCKY



Can you afford to lose his skill?

It may have taken years to train him. It may take less than a second to rob him — *and you* — of his skill... if his eyes go *unprotected* on eye-hazardous jobs.

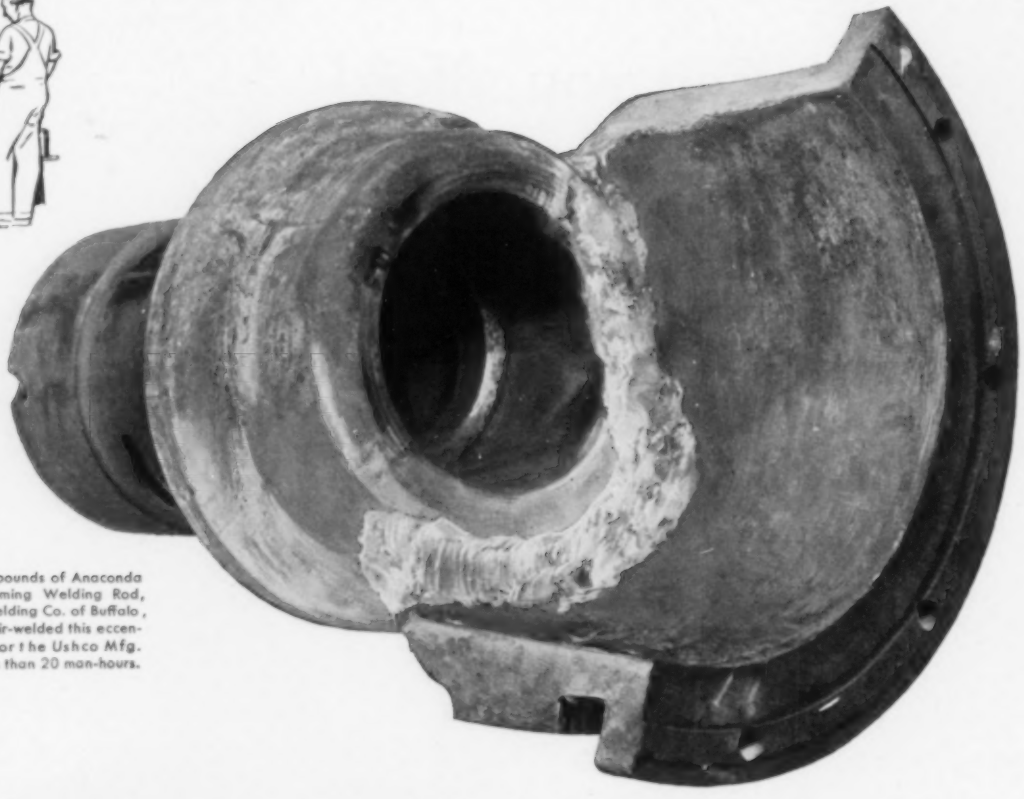
AO Goggles will protect him... *and you*

For about 75¢ per eye — the price of AO Safety Goggles — you can protect him and hundreds like him who keep your production *going*.

American Optical
COMPANY
SOUTHBRIDGE, MASSACHUSETTS

Call in an AO Man — and keep your "production eyes" producing.

Short, short story



Using only 18 pounds of Anaconda "997" Low Fuming Welding Rod, the Hebeler Welding Co. of Buffalo, New York, repair-welded this eccentric housing for the Ushco Mfg. Co., Inc., in less than 20 man-hours.

Important war production plant...
Eccentric housing breaks on drop forge hammer...
Welded with Anaconda "997" Low Fuming...
Hammer back on job next day!

That's the way low-temperature Bronze welding is helping out in emergencies these busy days. A broken 2½-ton gear was returned to service in less than a week; a seven-foot fracture in a 6-ton press column was repaired in three days; a fractured 2-ton section of a 100" boring mill was repair-welded in 39 hours.

And so it goes—in every branch of industry, on every type of equipment—on parts made of cast iron, steel, malleable iron and copper alloys.

Keep in mind this modern method of salvaging costly machine tools, production parts and equipment—at a fraction of the cost of new replacement parts. Keep in mind also that Tobin Bronze*, "997" Low Fuming and other Anaconda Welding Rods are preferred by many industrial shops for making dense, high strength, Bronze welding repairs.

*Reg. U. S. Pat. Off. 4978

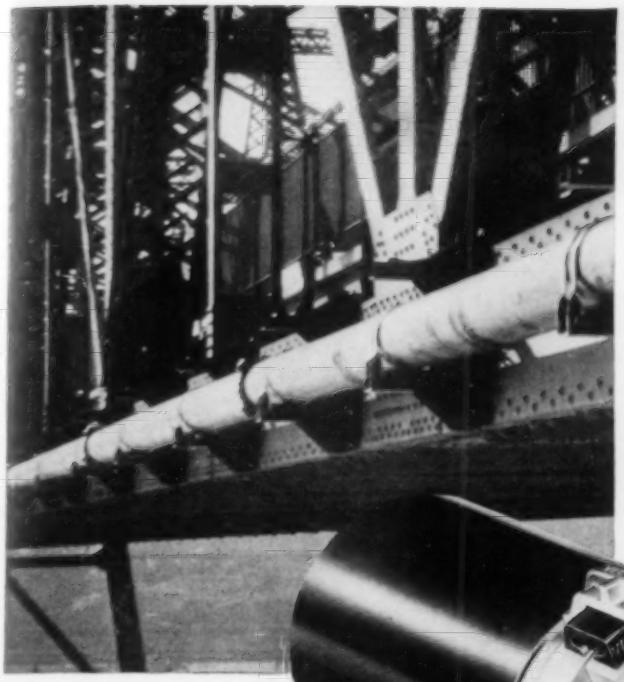
THE AMERICAN BRASS COMPANY
General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

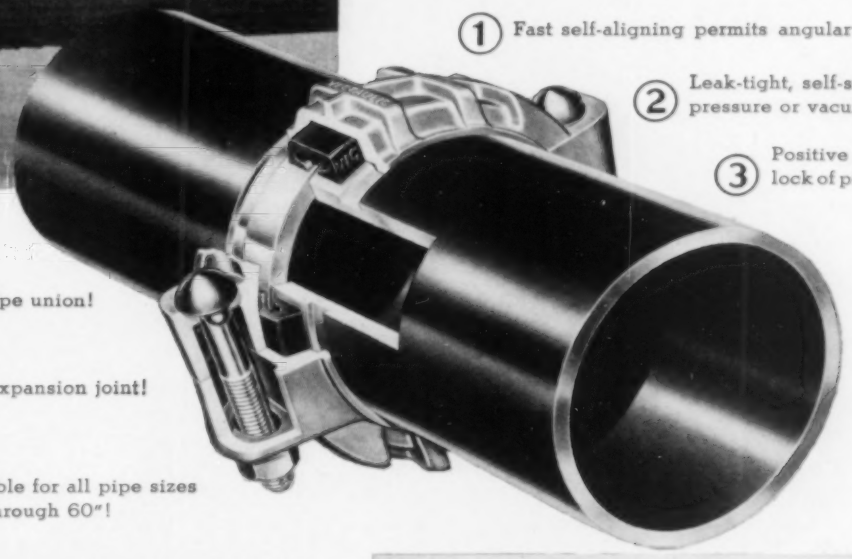
ANACONDA

Anaconda Welding Rods

The "Pipe Dream" that Worked...

Add up all the ideal specifications you'd make for a pipe coupling and what would you have? A coupling that would join two pieces of pipe together in a leak-tight joint quickly! A coupling green labor could use! A coupling that would be flexible enough so you wouldn't have to bother about accurate pipe alignment! That would give you positive mechanical lock and yet provide for expansion and contraction! The only thing about such a coupling is that . . . Brother it's no dream. It's a Victaulic. And it has more advantages than any "pipe dream" you ever had. For instance . . .





(1) Fast self-aligning permits angular deflection!

(2) Leak-tight, self-sealing under pressure or vacuum!

(3) Positive mechanical lock of pipe lengths!

(4) Every joint is a pipe union!

(5) Every joint an expansion joint!

(6) Available for all pipe sizes 3/4" through 60"!

SPECIAL VICTAULIC ADVANTAGES FOR INDUSTRIAL USERS!

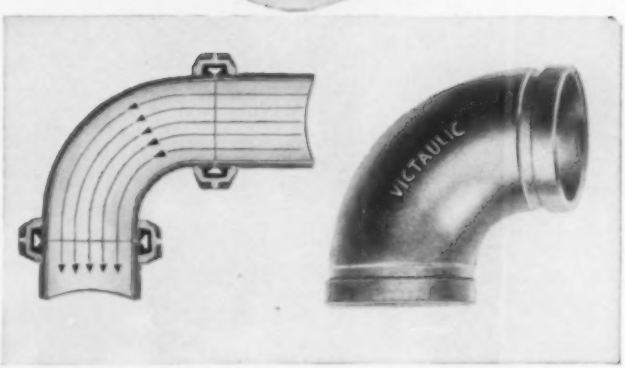
★ **Can be installed faster and with less labor than any other method!**

★ **Lower installation costs... unskilled labor can do the job.**

★ **No expensive equipment needed . . . one small wrench is the only tool required.**

★ **Substantial savings in space and weight.**

★ **Temporary lines can be salvaged 100 per cent. Maintenance is nil!**



VICTAULIC FULL-FLOW FITTINGS. Full-flow diagram at left illustrates efficiency principle used in Victaulic 90° Elbow, long sweep . . . smooth, true-circular walls with no internal projections, no pockets. Lower frictional losses mean increased delivery, lower pumping costs. Victaulic makes all styles of fittings for every piping need. Be sure to specify "Victaulic."

BUY MORE WAR BONDS

VICTAULIC

Reg. U. S. Pat. Off.

SELF-ALIGNING PIPE COUPLINGS AND FULL-FLOW FITTINGS

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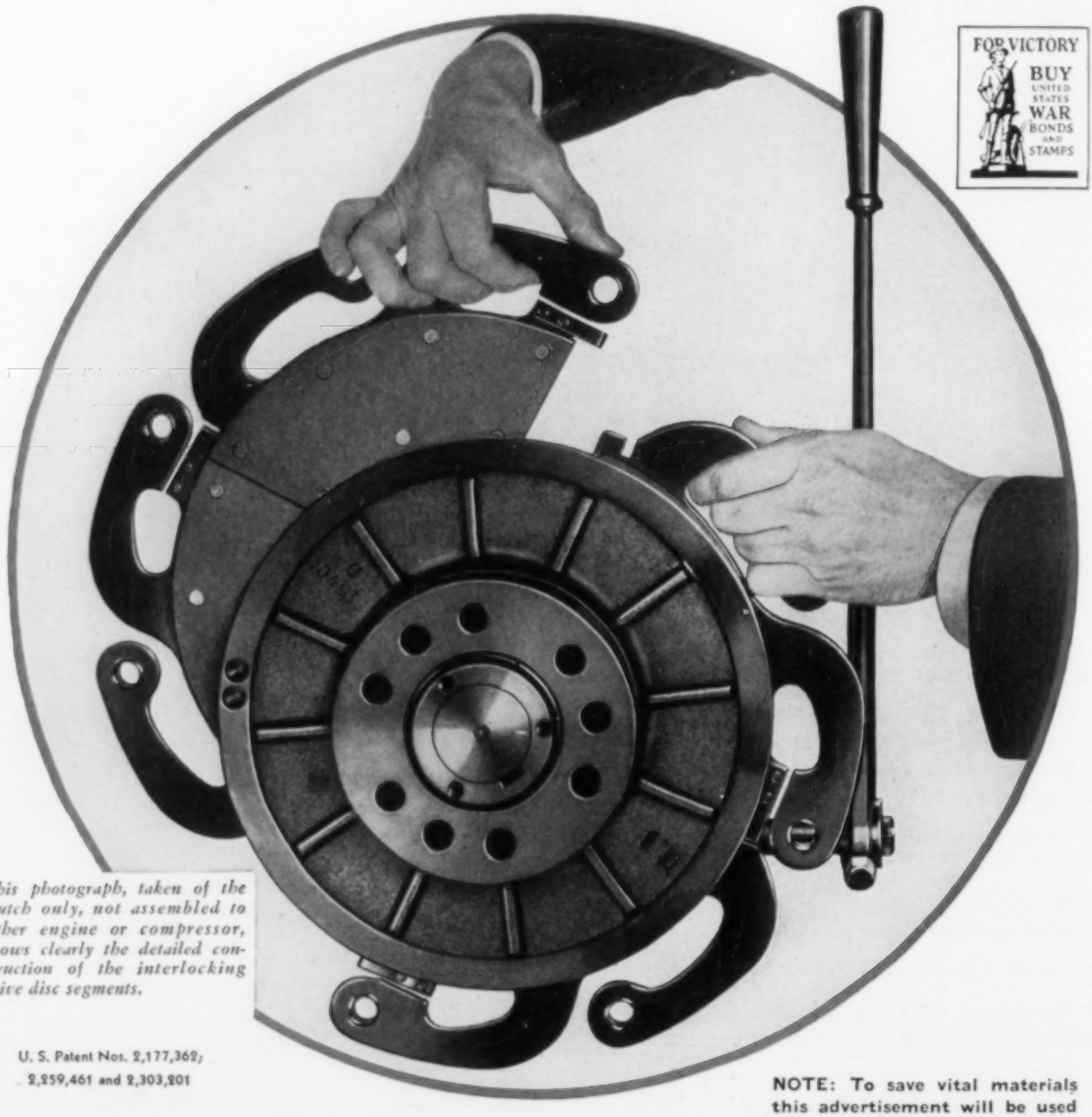
NEW VICTAULIC CATALOG MANUAL

. . . a must for every firm that uses pipe. Contains all you need know about Victaulic Couplings and Full-Flow Fittings. Write to nearest address for your copy today on your firm's letterhead. Victaulic Company of America, 30 Rockefeller Plaza, New York 20, N. Y.; Victaulic Inc., 727 West 7th St., Los Angeles 14, Calif.: Victaulic Co. of Canada, Ltd., 200 Bay Street, Toronto.

FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.



FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

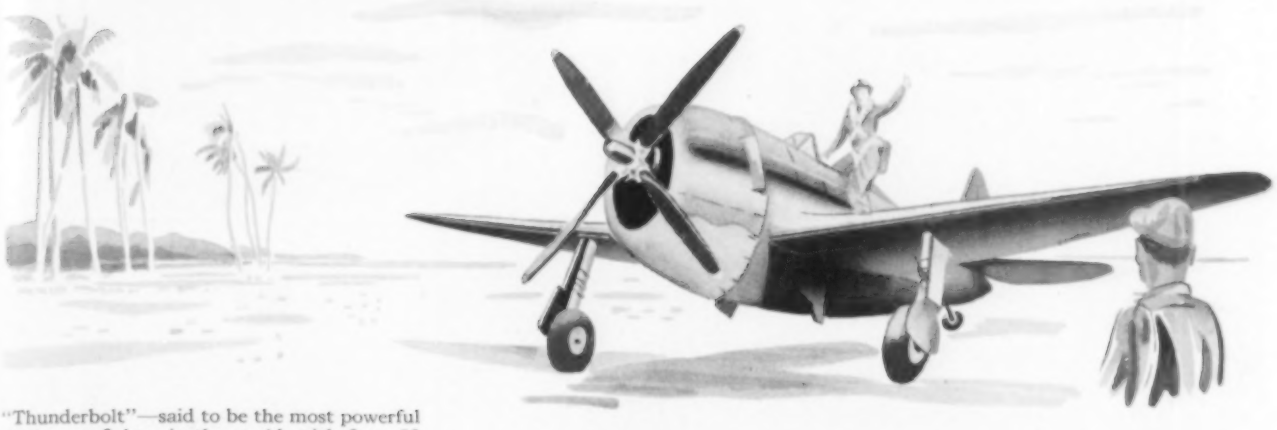
U. S. Patent Nos. 2,177,362; 2,259,461 and 2,303,201

NOTE: To save vital materials this advertisement will be used for "the duration."

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

The Army's Answer to a "MUST!"



"Thunderbolt"—said to be the most powerful single seat fighter in the world, with four .50 caliber fixed machine guns mounted in each wing panel, a flying speed of more than 400 m. p. h.—and a diving speed greater than the speed of sound.

"Musts" are constant in industrial, as in military achievements. And the only "stock-bin" out of which "musts" are solved is the stock-bin of experience and specialized application. POWELL, for nearly one hundred years, has made valves, and valves only . . . valves for all flow control requirements . . . valves for the "must" requirements in all fields of industry . . . in war or peace . . . through ten decades of industrial progress. Our experience in producing *the* valve to do *the* specific job—"to meet the must"—is yours on request.

Fig. 95 (left)—Bronze "White-Star" Dash-Pot Check Valve is designed for air compresser service. It has screwed ends, screwed cap and regrindable, renewable "Powellium" nickel bronze disc. Because of the cushioning effect of the plunger in the dash-pot, the seating of the disc is practically noiseless.

Fig. 1708 (below)—Bronze Globe Valve for 200 pounds W. P. Has screwed ends, union bonnet, renewable, heat-treated stainless steel seat and regrindable, renewable "Powellium" nickel-bronze semi-cone plug-type disc.

Fig. 150 (left)—Bronze Globe Valve for 150 pounds W. P. Has screwed ends, union bonnet and vulcanized composition disc.

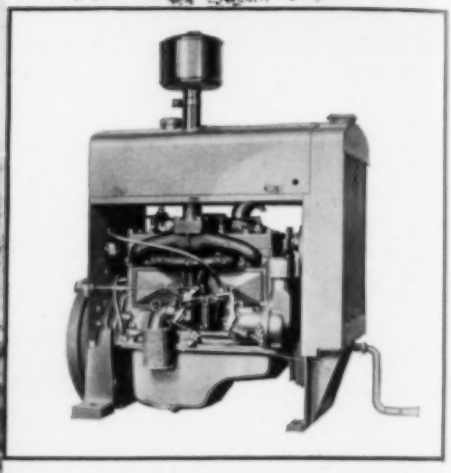
The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

POWELL VALVES

WAUKESHAS IN WAR WORK "somewhere in Alaska"



MODEL FCU WAUKESHA ENGINE — A rugged 4-cylinder power plant, 3¼" bore x 4" stroke, 133 cu. in. displ., for operation in 20 to 30 hp. range.

• In wartime every Waukesha Engine is a war-work engine. Here are two Waukeshas on a government war-work installation "somewhere in Alaska." You can barely see the housing of the one powering the Rex 28-S Concrete Mixer . . . it's just above the mixer drain.

The other is driving a Rex 160 Pumpcrete. This Model FCU Waukesha Engine is as rugged as the terrain of Alaska. To power the pump that pumps concrete—as far as 800 ft., or as high as 100 ft.—it *has* to be rugged. But it's *smooth*, too . . .

Structurally rigid and finely balanced . . . that's why! Cylinders and crankcase are one piece. The husky, closely balanced crankshaft . . . fitted with accurately matched piston and rod assemblies . . . rides on three renewable precision-type bushings, each 2⅛" in diameter and that's big for a small engine like this.

Its Waukesha Blue Flame Manifold, in combination with the Controlled Turbulence combustion chamber, gives instant response to power and load requirements . . . and more power with less fuel at partial or varying loads under which most engines usually work.

Today every Waukesha is made for war work. Find out about Waukesha Engines for *your* future peacetime needs.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.
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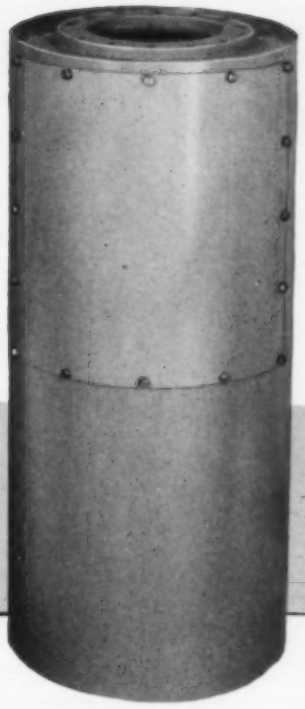
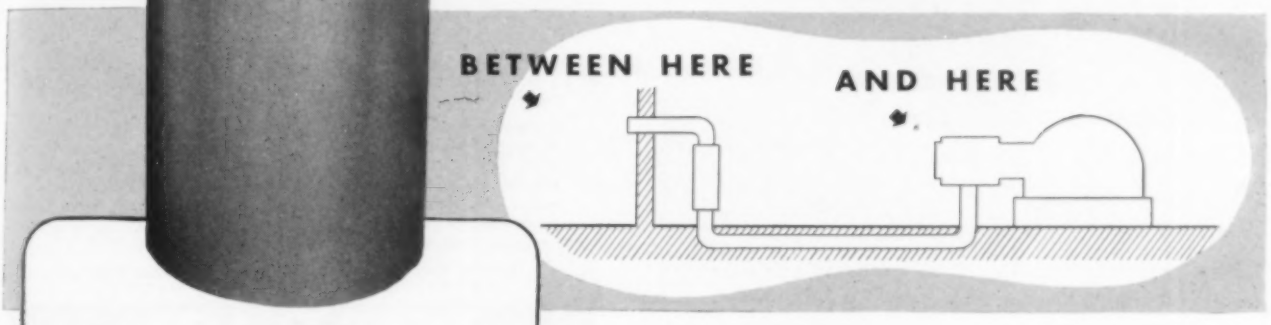
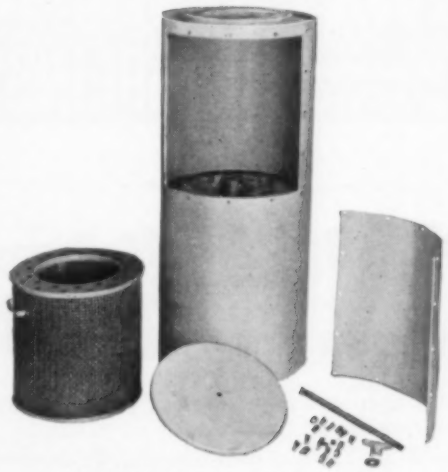
MORE POWER FOR VICTORY

WAUKESHA ENGINES

NEW *in-Line* FILTER-SILENCER FITS ANYPLACE







Multimaze (viscous impingement) type in-line filter. Disassembled, showing ease of inspection and servicing.

Air-Maze filters fit the job. The Air-Maze line includes more than 3,000 types of filters. Send for catalog AGC-144 showing typical filters and installations.

Don't compromise on these two vital locations!

★ The coolest, cleanest air for your engine and compressor and the handiest location for intake filters often are far apart.

Cool air increases the volumetric efficiency of your equipment. High inlets often reduce dust concentration of intake air. Convenient location speeds and simplifies filter inspection and servicing.

The new Air-Maze *in-line* (closed circuit) filter-silencer—available in both oil-wetted and oil-bath types—ends the need for compromise on these important considerations. Designed on the proved Air-Maze principle, this new unit offers efficient, dependable protection, effective silencing and complete flexibility of induction system design.

We shall be glad to make recommendations for your particular installation.

AIR-MAZE CORPORATION • *Engineers and Manufacturers* • **CLEVELAND 5, OHIO**

Representatives in Principal Cities • *In Canada:* **Williams & Wilson, Ltd., Montreal, Quebec, Toronto, Windsor; Fleck Bros. Ltd., Vancouver, B. C.**

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Examine the design of the WALDRON Coupling. Freedom of movement between hub and sleeve prevents stress on shaft; Walflex Seal gives positive protection against leakage of dust or oil; absence of non lubricated metal against metal on moving parts prevents wear; forged steel hubs and sleeves—no welding—eliminates cause of frequent repairs or replacements.

WRITE FOR CATALOG CONTAINING DESIGN AND CONSTRUCTION DETAILS, RATING TABLES ETC.

JOHN WALDRON CORP.
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COUPLINGS

PUMP OPERATORS DATA—170 Pages of Useful Information for $2.00

This new handbook has been prepared especially for the man who installs, operates or services centrifugal pumps.

It is a thoroughly practical book. The ten, well-illustrated chapters, as listed below, cover practically all of the points that the pump man should know and follow to successfully handle modern centrifugal pumps.

Chapter 10 contains friction tables and much other data which are needed daily in hydraulic work.

The book is carefully sewed and is well-bound in imitation leather. It will stand up for years under hard service. Twenty memoranda pages in the back of the book provide space for records and data on personal experiences.

CHAPTER HEADINGS

1. Installation
2. Starting and Operation
3. Maintenance
4. Operation Difficulties
5. Priming Methods
6. Bearings and Lubrication
7. Stuffing-Box Arrangements
8. Packing
9. Definitions and Formulae
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14-504

COMPRESSED AIR... *Speeds Aircraft Maintenance*

This lightweight drill speeds repairs on the tail section of a transport plane in the PAA hangar at Miami.

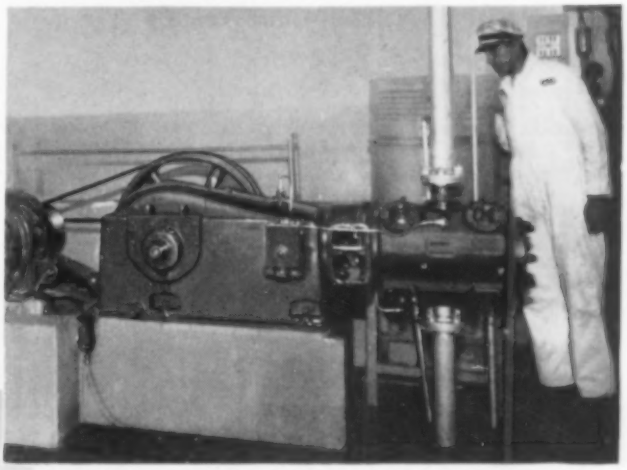
Air tools play a big part in keeping aircraft "flightworthy."

Air tools are lighter in weight and easier to handle than other power tools of equal capacity. Air tools can be started and stopped instantly. Torque and speed can be varied throughout the capacity range — full power is available at the squeeze of the throttle.

Your operators can do an easier, quicker and better job with air tools. The I-R line includes drills, riveters, grinders, wrenches, and many other labor-aiding air tools.

For your compressed air supply you can choose from the wide range of I-R stationary and portable compressors. There is a size and type to fit every application.

Let the nearest Ingersoll-Rand engineer give you the facts.



Single-stage, Type ES heavy-duty compressor which supplies air for many uses at the PAA Airport in Mexico City.

Ingersoll-Rand

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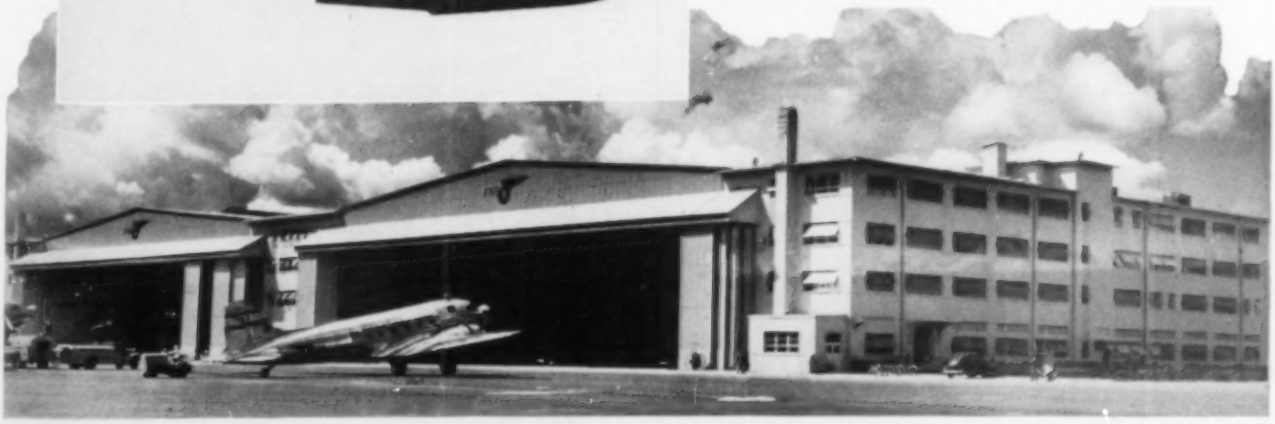
Photos courtesy Pan American World Airways System 8-465

View of the modern airport of the Pan American Airways System in Miami. Inset shows one of the famous Clippers.



COMPRESSORS • TURBO BLOWERS • AIR TOOLS • ROCK DRILLS • CENTRIFUGAL PUMPS • CONDENSERS • OIL AND GAS ENGINES

Reducing Complex Operating Cycles to Finger Tip Touch

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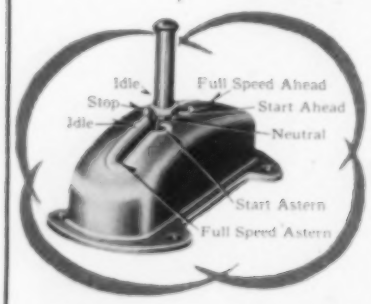
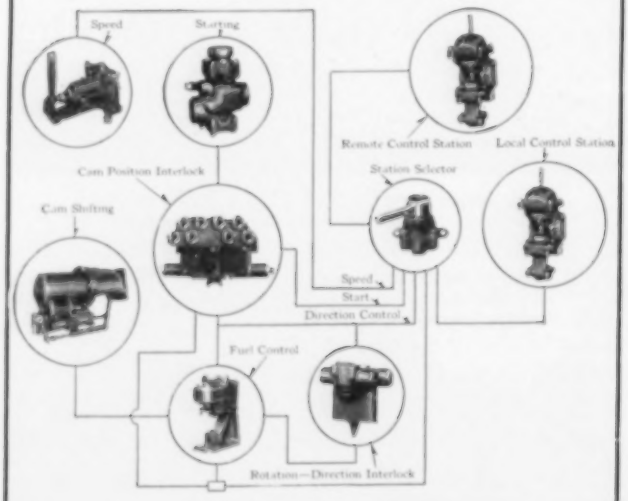


W·A·B Pneumatic Controls

W·A·B Control Systems simplify operating cycles by centralizing control of related functions in a single lever. Interlockings protect equipment—speed, shifting, reversing, and fuel sequences cannot be altered by mishandling.

The diagram below shows the control system for a direct reversing Diesel engine. Engine rotation from full speed ahead or astern is reversed, merely by moving the lever to the start notch in the opposite quadrant.

In preordained sequence: fuel is cut off, cam shaft is shifted, engine stops and starts rotating in opposite direction, fuel is cut in.



W·A·B Pneumatic Control, engineered to your product, will simplify the controls, protect the equipment.

•

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Industrial Division - - - Wilmerding, Pa.

It's to YOUR Advantage to use

Wagner Air-Cooled TRANSFORMERS

Because they are—

Safe for either indoor or outdoor installation.

Compact and easy to install.

Usable right at load.

STUDY THESE FEATURES:

1. Dry-type…no liquid.

2. Core and coils are vacuum treated in compound for protection against moisture.

3. Totally enclosed.

4. Provided with built-in junction box with knockouts on sides and bottom for conduit or open wiring.

5. Large removable coverplate of junction box assures ease in making connections.

6. Hanger-lugs designed for ease in mounting.

7. All ratings within the limits of the National Board of Fire Underwriters have the Underwriters' approval.

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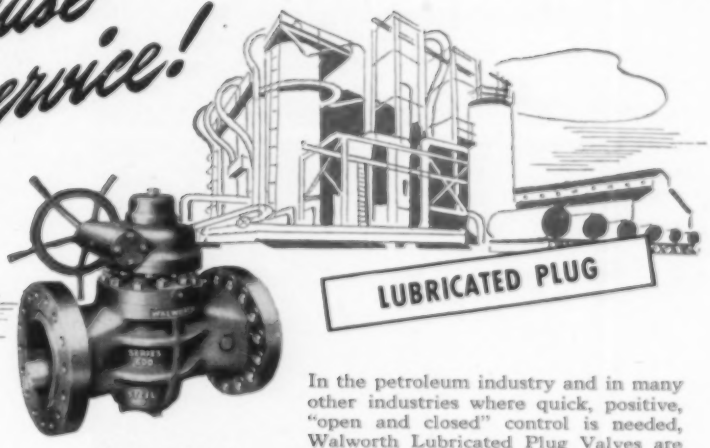
ELECTRICAL AND AUTOMOTIVE PRODUCTS

WALWORTH STEEL VALVES

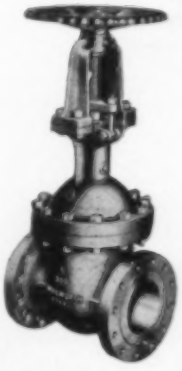
Specified because they fit the service!



LUBRICATED PLUG

In the petroleum industry and in many other industries where quick, positive, "open and closed" control is needed, Walworth Lubricated Plug Valves are widely used. This one shown is a worm gear operated, steel, ball bearing type valve for 600 psi. Other Walworth Steel Lubricated Plug Valves are made in sizes from ½" to 24", for pressures from 125 to 5000 psi, and for vacuum.

GATE AND GLOBE

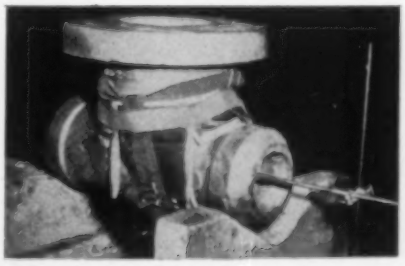


Walworth manufactures gate and globe type cast steel valves for 150 to 1500 psi Steam;—Oil, Water, and Gas pressures up to 5000 psi. The Walworth Series 300 gate valve shown is made in sizes from 2" to 24". Its streamlined ports, deep stuffing box, oversize stem, and heavy wall thickness assure long and reliable service.

MOTOR OPERATED

This 12" Walworth motor-operated cast steel gate valve is one of many motor-operated valves built by Walworth for power plant service. It is designed for 1500 psi Steam at 950F. The pressure castings are of carbon molybdenum steel, and the wedge and seat rings are stellite faced. Walworth Steel Valves can be furnished with air, gas, or electric motor operating units and with or without by-passes as required.

RADIOGRAPHIC INSPECTION



For many years Walworth has been using gamma-ray technique for the study and improvement of the heavier and varying sections of steel valves and fittings. This is just one of many ways in which Walworth research and engineering pre-prove Walworth products.

Walworth manufactures a complete line of bronze, iron and steel valves and fittings. For a detailed description of the entire Walworth line, write on your company letterhead for Catalog 42.

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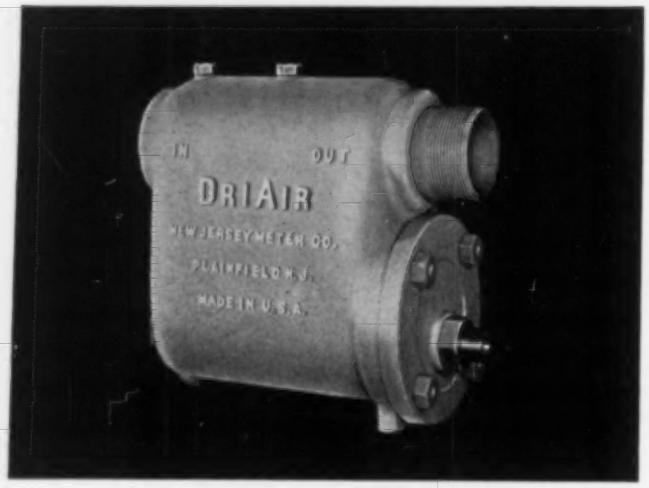


WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

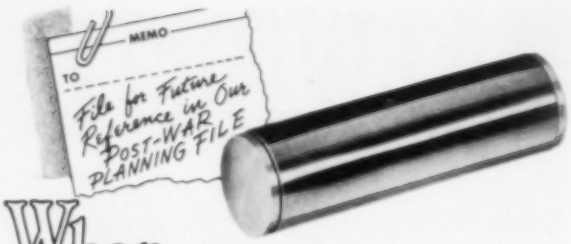
DriAir may be installed by suspending it from the piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

● The answer to many problems which arise in various applications of compressed air, DriAir speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request; write today.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY



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about Burgess-Norton's production achievements and developments in the manufacture of . . . . .

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of all types including aircraft with finishes to 2 micro inches . . . in the field of

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where with the largest and latest type "*controlled atmosphere*" electric furnaces, copper brazed and heat-treated parts are being mass produced in one continuous operation . . . in the field of

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where highest production rates are being achieved without sacrifice of quality uniformity . . .

. . . . you will discover much that will be to your advantage in post-war production.

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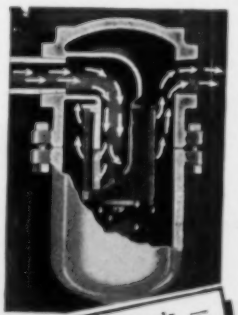
For dry, clean, oil free COMPRESSED AIR

USE THIS 2-WAY SEPARATOR

WATER, dirt and oil have no place in compressed air. They deteriorate air hoses and equipment rapidly, besides causing imperfect results in many services.

The Johnson Gast Separator combines the two most effective methods of removing these objectionable substances. First the air is allowed to expand, precipitating most of the moisture. Then it passes through the "thousand baffles", changing direction of flow many times and surrendering particles of water and dirt at every turn.

When water has been vaporized by the heat generated in compressing air, the Johnson Gast Aftercooler is installed ahead of the separator to condense the vapor. For services where every trace of oil must be removed—as in paint spraying—the Johnson Gast Oil Absorber is used.



1. Air expands — precipitates moisture.
2. "Thousand Baffles" change flow direction—capture remaining water and dirt.

Write for Bulletin

THE JOHNSON CORPORATION
830 Wood St., Three Rivers, Mich.

Johnson Gast Separators also available for use on steam lines.

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SEPARATORS • AFTERCOOLERS • OIL ABSORBERS

It "Grips like Magic" to Give you faster, safer, better Mounting!

Allis-Chalmers' new "Magic-Grip" is the *fastest mounting sheave on the market.* Three cap screws lock tapered split bushing, sheave and shaft securely . . . *in one operation.*

YOU get smoother running performance with "Magic-Grip" because . . . its positive clamp fit grips motor and machine shafts uniformly, eliminating back-lash and shear.

Vibration and stress resulting from shaft overhang are greatly reduced, too, since new design allows the sheave that "grips like magic" to be mounted closer to motor. Motor bearing life is lengthened.

Allis-Chalmers' new "Magic-Grip" sheaves are stocked in a complete line *at no increase in price.* Now, more than ever, it pays to make Allis-Chalmers your "V-Belt Drive Headquarters."

For full data, ask our district office or dealer for bulletin B6310. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

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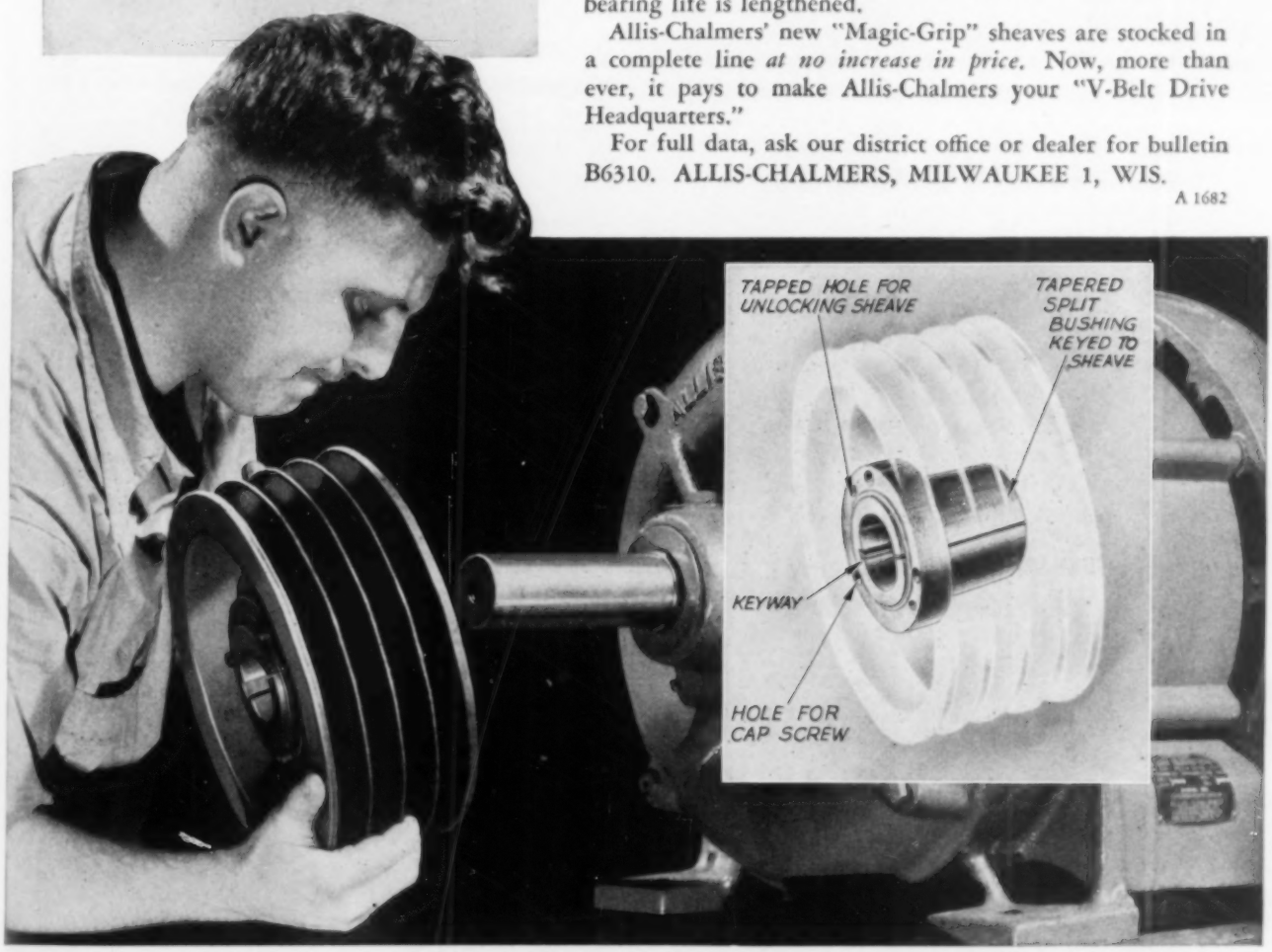

Allis-Chalmers Texrope "MAGIC-GRIP" SHEAVES

On Active Duty Everywhere

Both at home and abroad Garlock products are doing a job—on warships, planes, tanks and in industrial plants which are manufacturing war products and essential goods. Engineers everywhere rely on the dependable performance of Garlock packings, gaskets and KLOZURE oil seals.

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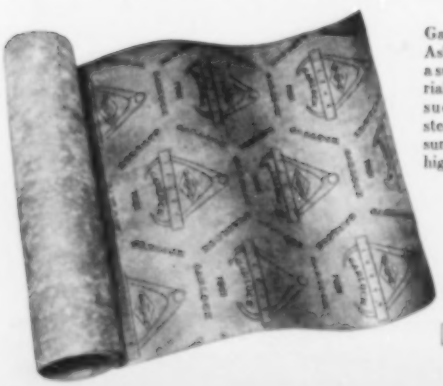
In Canada: The Garlock Packing Company of Canada, Ltd., Montreal, Que.



Garlock 7021 Compressed Asbestos Sheet Packing is a superior gasketing material for severe conditions, such as super-heated steam at extreme pressures and light oils at high temperatures.

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A safe, lasting and easy-to-put-on clip for every size of rope from 1/8-inch to 4-inch.

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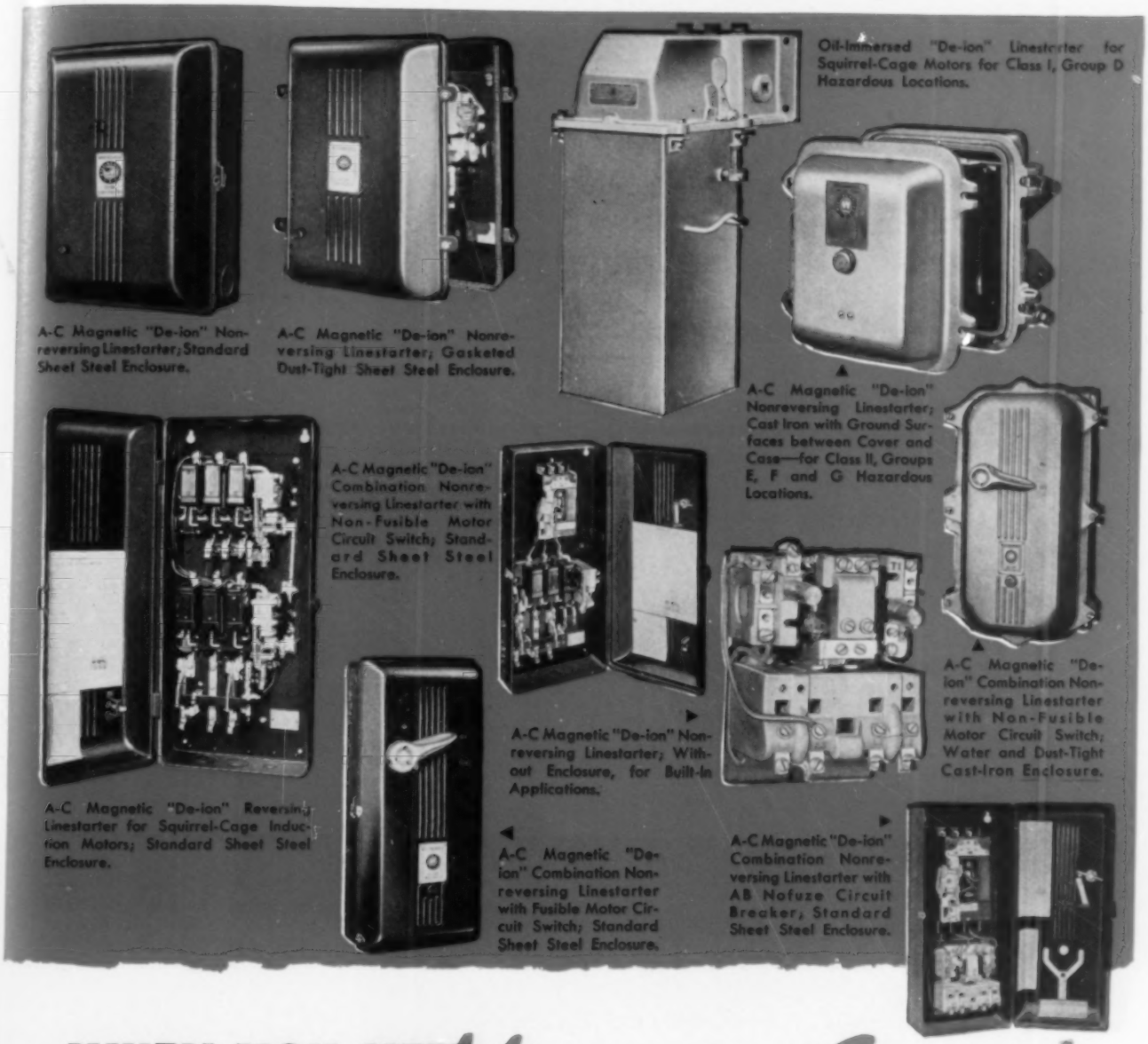
THE GENUINE *Crosby Clip* WHEREVER WIRE ROPE IS FASTENED



A-C Magnetic "De-ion" Nonreversing Linestarter; Standard Sheet Steel Enclosure.

A-C Magnetic "De-ion" Nonreversing Linestarter; Gasketed Dust-Tight Sheet Steel Enclosure.

Oil-Immersed "De-ion" Linestarter for Squirrel-Cage Motors for Class I, Group D Hazardous Locations.

A-C Magnetic "De-ion" Nonreversing Linestarter; Cast Iron with Ground Surfaces between Cover and Case—for Class II, Groups E, F and G Hazardous Locations.

A-C Magnetic "De-ion" Combination Nonreversing Linestarter with Non-Fusible Motor Circuit Switch; Standard Sheet Steel Enclosure.

A-C Magnetic "De-ion" Nonreversing Linestarter; Without Enclosure, for Built-In Applications.

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WHEN YOU NEED *Magnetic Controls*

FOR SINGLE-PHASE AND SQUIRREL-CAGE MOTORS CONSULT WESTINGHOUSE BUYING DATA (NEW CATALOG 7000)

With the new Westinghouse Buying Data, you can select and purchase the proper motor control in half the time.

Data, as presented, is striking in its newness. It's easier to read, easier to understand, and easier to use than any published previously by any manufacturer.

Chances are—if you are a buyer of motors and controls—that you have already received a copy of this new Catalog 7000 by mail. However, if you have not received your copy, write, wire or phone your nearest Westinghouse district office. (Requests will be filled through district offices only — no mailing from Westinghouse headquarters at East Pittsburgh.) J-60552

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PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

De-ion Linestarters

MIRROR-FINISH CYLINDER HONING

is a Production MUST for ALL WISCONSIN ENGINES

Yes . . . even the little Model AA 1 hp., single-cylinder Wisconsin Air-Cooled Engine has its 2¼"-bore cylinder honed to a high mirror finish . . . to assure smooth, full-power operation and maximum fuel and maintenance economy.

No "hidden detail" of design and construction is neglected or sacrificed to "price expediency" in the manufacture of these fine engines. These details are important to YOU in the operation of *your equipment*. Wisconsin air-cooled engine power is the answer.

Most H.P. per pound

WISCONSIN MOTOR Corporation

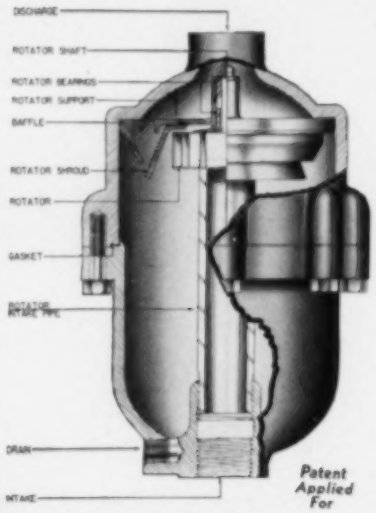
MILWAUKEE 14, WISCONSIN, U. S. A.

World's Largest Builders of Heavy-Duty Air-Cooled Engines

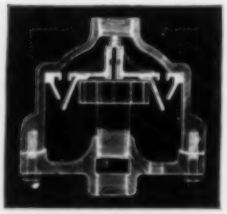
NEW TURBO-ROTOR *Pur-O-fier*

For Compressed Air

This new unit effectively eliminates moisture, oil and scale from compressed air lines. Pur-O-fier utilizes the principle of centrifugal force to separate entrainments from purified air. Once installed it requires absolutely no maintenance. Penstar Tru-Bond oiless bearing guarantees long, trouble-free operation. Manual or automatic drains provided.



Patent Applied For

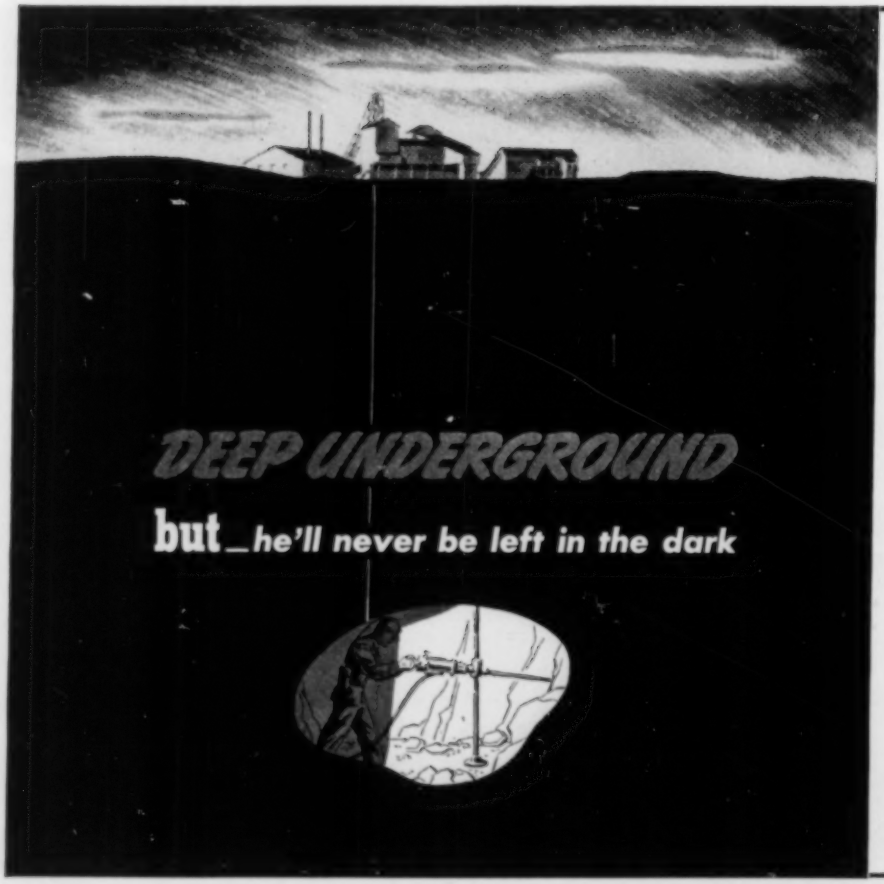


Drawing shows turbo-rotor, shroud and baffles. The design of the baffles precludes the possibility of capillary action of entrainments resulting from high velocity.

THREE MODELS AVAILABLE—A-1 will accommodate volumes from ½ to 5 cu. ft. A-2, volumes from 10 to 35 cu. ft. A-4, volumes from 35 to 100 cu. ft. Multiple units are recommended for volumes above this range. Pur-O-fier is the only standard unit that can be engineered to meet any air volume for regular or intermittent service.

BIRD-WHITE COMPANY

3120 West Lake Street, Chicago, Illinois



KEEPING faith with the miner in his fight for production victory is the steadfast dependability of the Edison Electric Cap Lamp. Furnishing more effective light, in greater volume, for greater daily tonnage, the Edison Lamp is engineered and built for continuous trouble-free service—to the last specification and the last ounce of material.

Better light makes better miners—and the Edison Lamp lives up to its responsibility of providing better light throughout every shift. Armed with the Edison Lamp and its sturdy companion, M. S. A. Skullgard, today's miner is well-protected against underground hazards—while doing an essential job for America.

MINE SAFETY APPLIANCES CO.

Braddock, Thomas and Meade Streets

PITTSBURGH, PENNA.

District Representatives in Principal Cities

TEETH for biting stubborn rock

Locked beneath the earth's surface are the vast treasures of metallic ores that make possible a steady flow of weapons to America's fighting men.

Helping extract these ores is one of the wartime jobs of Bethlehem Superior Hollow Drill Steel. In the Lake mining districts, the Tri-State lead areas, the non-ferrous metal regions of the Southwest . . . and in every other important mining center the country over, this old favorite is teaming up with sinker, drifter, and stoper drills to produce more metal for war uses.

On pipe-line jobs, too . . . and in the building of airports, flight strips, hydro-electric projects, and vital war-needed highways, this hard-bitten veteran drill steel is showing the qualities that have always made it a favorite among construction men.

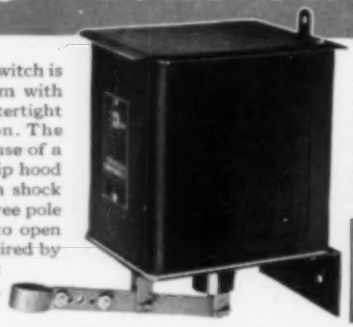
Bethlehem Superior is easier to get these days, but there's none to waste. So, if you're using it, be sure of maximum footage from every bar. Proper heat-treatment is one of the best ways to insure keen-edged, long-lived drill steel. Write to Bethlehem Steel Company, Bethlehem, Pa., for Booklet 83-C, which includes heat-treating recommendations and other useful data.

★ BETHLEHEM STEEL ★

Bethlehem Superior Hollow Drill Steel

Marine FLOAT SWITCH

DRIPPROOF AND WATERTIGHT
HIGH SHOCK CONTACT BLOCK
TWO OR THREE POLE
CLASS 9036 • TYPE AW-H



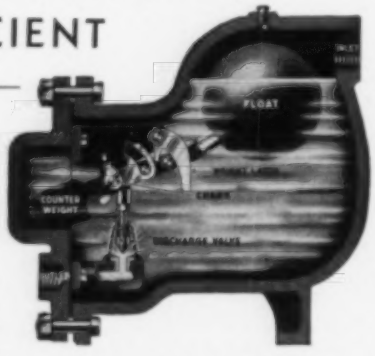
● The class 9036 type AW-H float switch is built for Marine Service to conform with requirements for a dripproof and watertight device of shockproof construction. The switch differs from standard in the use of a special sheet steel enclosure and drip hood with gasket seal and a special high shock bakelite contact block of two or three pole form. The switch can be arranged to open or close on rise in liquid level as required by application. Mounting is three point by means of bracket flange and foot, as illustrated. **Write for Bulletin 563.**

ELECTRICAL RATINGS

Voltage	Single Phase A. C.	Polyphase A. C.	D.C.
110V.	2 H.P.	3 H.P.	1 H.P.
220V.	3 H.P.	5 H.P.	1 H.P.
440-550	5 H.P.	5 H.P.	.....
32V.	.....	.....	½ H.P.

REGULATOR DIVISION
SQUARE D COMPANY
DETROIT • MICHIGAN

★ TROUBLE-FREE
★ DEPENDABLE
★ EFFICIENT



The
NICHOLSON
Model "JR"

COMPRESSED AIR TRAP

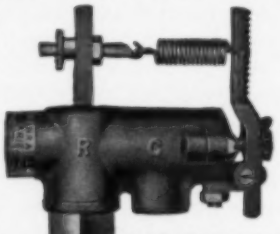
Has "All 3" Major Virtues

Its wide use under all kinds of working conditions proves its superior effectiveness in draining water and oil from air tanks, receivers, aftercoolers, etc. Large capacity. Pressures to 200 lbs. Bulletin No. 341.

W. H. NICHOLSON & CO.
180 OREGON ST., WILKES-BARRE, PA.
Valves ★ Traps ★ Steam Specialties

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



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STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET - ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

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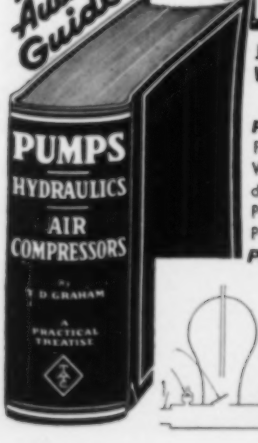

PUMPS-HYDRAULICS-AIR COMPRESSORS

JUST OUT! 3 BOOKS IN ONE—OVER 1650 PAGES, 1654 ILLUSTRATIONS, WITH QUESTIONS AND ANSWERS. COMPLETE PRACTICAL CONCISE INFORMATION FOR ALL ENGINEERS AND OPERATORS.

***PART 1*—PUMPS—850 Pages:** All types—Centrifugal—Rotary—Reciprocating Pumps: Their Theory, Construction, Operation and Calculations. Air and Vacuum Chambers—Power Pumps—Air Pumps—Jet Condensers—Surface Condensers—Condenser Auxiliaries—Condenser Operation—Calculations—Cooling Ponds—Cooling Towers—Water Supply—Hydraulic Rams—Special Service Pumps—Automotive Fire Pumps—Dredges—Codes. 942 Illustrations.

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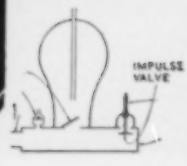

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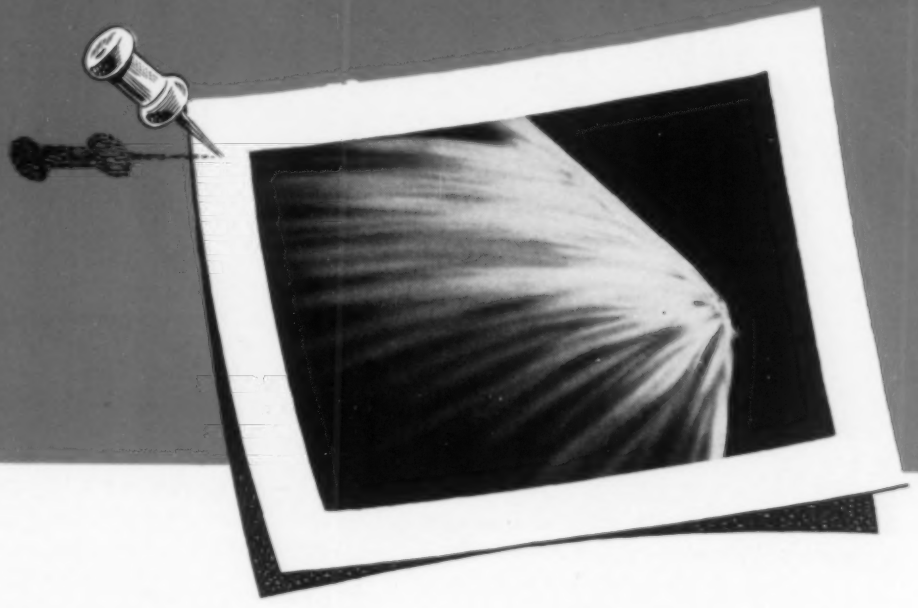
SNAPSHOT of an explosion



HERE IS A STORY OF AN EXPLOSION—as told by the explosive itself. The narrow, white streak at the right is the path of detonation, flashing through the explosive at about 250 miles a minute! The feathery haze is a photographic record of white-hot gases bursting outward at tremendous pressures as high as a million pounds to the square inch.

Facts such as these are recorded, studied, and analyzed by Hercules scientists. Each day scores of research projects are carried on to broaden the knowledge and understanding of explosives. It is through constant, intelligent research that we endeavor to help you and thus benefit ourselves.

HERCULES EXPLOSIVES

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XP-44

Designed for PEACE

January 1941

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Ingersoll-Rand

MOBIL-AIR

AIR POWER

Another

NEW STANDARD IN PORTABLE COMPRESSORS

A Startling New Development full of MONEY-SAVING FEATURES

The MOBIL-AIR has a Convertible Engine . . . You can change from oil to gasoline operation (or from gasoline to oil) by a simple substitution of fuel accessories . . . in your own shop . . . no changing of engines or engine heads or pistons. The engine has overhead valves, replaceable cylinder liners, non-sticking piston rings and other refinements.

As a Gasoline Engine this outstanding new development requires much less fuel . . . particularly at light loads.

As an Oil Engine it is the well-known Ingersoll-Rand Type H . . . smooth running, easy to maintain, easy to start.

DRILL-MORE Multi-speed Regulator (patented) adjusts the engine speed to the use of air . . . practically eliminates wasteful "idling." The average working speed of the engine and compressor is reduced . . . more efficient operation . . . less wear.

More Work from Air Tools . . . Jackhamers and similar air tools drill up to 15% faster when the compressor is equipped with the DRILL-MORE Regulator.

Remarkable Fuel Economy . . . up to 40% less fuel to do an average job. The new Two-Stage Air-Cooled Compressor, the new High-Economy engine, and the new DRILL-MORE regulator result in 15% more air per gallon of gasoline at full load—83% more at half load.

New-Type Clutch has automatic take-up . . . no sliding splines . . . easy to inspect and reface.

New Instrument Panel, Grouped Controls and many other distinctive features.

Lighter in Weight . . . Easier to Handle . . . 15 to 33% less weight than previous models.

New Mountings . . . Both the 105- and 160- cu ft sizes are now available in the 2-wheel deluxe trailer mounting . . . the 210- and 315- cu ft sizes have a new spring mounting with automotive steering as standard.

Ask our representative for details . . . let him show you the many other points of superiority

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y.

A Complete Line of Two-Stage Air-Cooled Portable Compressors

Sizes 60 to 500 cfm (actual free-air delivery)

. . . . A "Natural" for WAR

During 1941, MOBIL-AIR Compressors set new standards of design and performance. These features were recognized immediately, and our performance claims were substantiated in the field.

Then came Pearl Harbor! More and more portable compressors were needed. MOBIL-AIR units were sent there and to every other front. Thousands of them. Some run on gasoline, some on oil. And these compressors are making substantial savings in vital fuel, and in the shipping space needed to transport the machines and the fuel to operate them.

Three years of strenuous service at the front and on the Nation's construction programs have proven the value of all MOBIL-AIR features. In addition, they have definitely established the durability, stamina, and the easy operation and maintenance of these finely built machines.

The convertible-engine feature has afforded an interchangeability of parts which simplifies and reduces the cost of supplying spares to wide-spread war zones. It has also enabled the procurement branches of the Armed Services, and those of our Allies, to order ahead and insure scheduled shipments . . . the choice of oil or gas engine drive being made later to suit ever-changing war conditions.

You will want your next Portable to be a MOBIL-AIR

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COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS • CENTRIFUGAL PUMPS
CONDENSERS • OIL AND GAS ENGINES

2-438

LITTLE THINGS
That lead to big dragline output

In addition to such major factors in dragline output as job layout, operator's skill, careful lubrication, proper clutch and brake adjustment, etc., a host of details can swell the production record. Here are just a few:

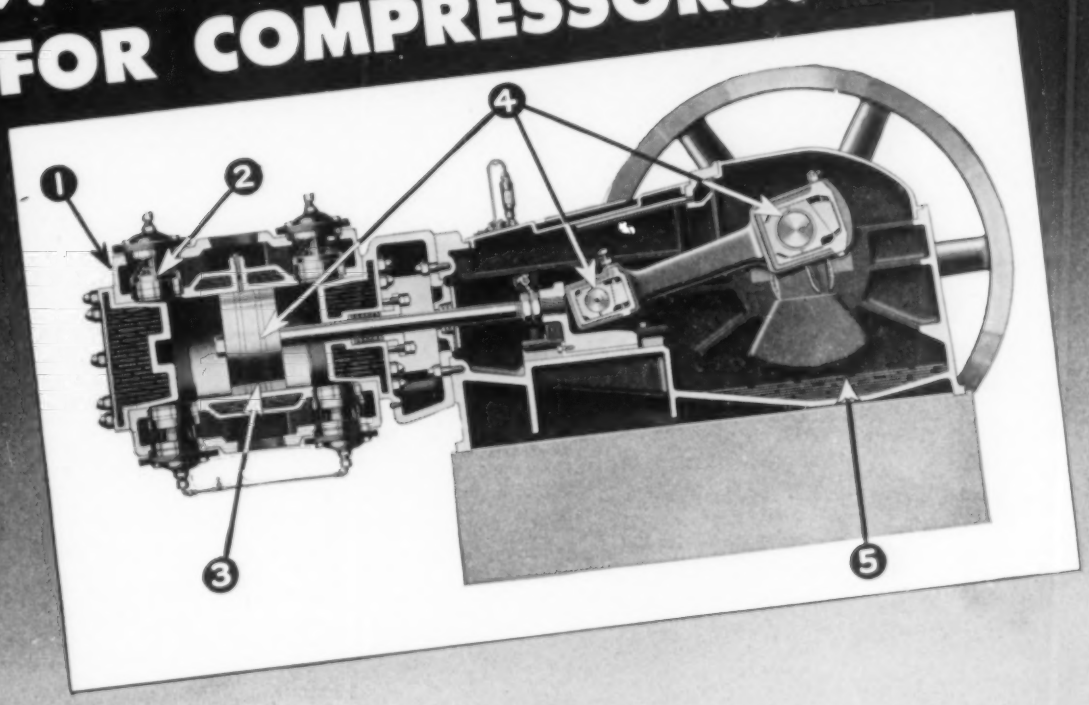
1. Keep boom at highest angle possible for particular job.
2. Do not use bucket of larger capacity than recommended for normal rapid operation.
3. Keep bucket teeth sharp and built up to proper size. This will protect lip from unnecessary wear, as well as increase digging speed.
4. Inspect drag chains regularly, paying particular attention to end links which are subject to greatest wear. Chain life can often be increased by reversal or by cutting chain in middle and using repair links to reverse sections.
5. Do not pull drag chain into fairlead.
6. Hoist bucket from digging as soon as it is filled.
7. Watch fairlead. Keep sheaves lubricated and well bushed. Clean out regularly dirt brought in by rope.
8. Short lengths of cable salvaged from hoist or drag ropes can be used for dump cable. Be sure length is same as original dump cable to insure best dumping characteristics.

BUCYRUS ERIE

Bucyrus-Erie

SOUTH MILWAUKEE, WISCONSIN, U. S. A.

A "LAZY" OIL WON'T DO FOR COMPRESSORS!



IF your compressor oils are not doing *all* of the jobs listed in the box at right they're "lazy" . . . should be changed. For "lazy" oils cause excess wear of pistons and bearings, make more frequent replacements necessary. And you know how scarce replacement parts are these days . . . how long it takes to get deliveries.

Keep your compressors "on the job" with hard-working Shell Compressa Oils. They have *all* of the characteristics necessary to trouble-free compressor performance. Call in the Shell man now for the full details.

SHELL COMPRESSA OILS KEEP COMPRESSORS ON THE "GO"

1. Are highly stable under severe operating conditions . . . do not break down at high temperatures.
2. Prevent excessive carbon formation on valves.
3. Help prevent ring-sticking and blow-by . . . assure effective sealing of pistons.
4. Assure low oil consumption and reduce wear by covering all sliding and rotating parts with a tough, adherent film.
5. Have high resistance to emulsification.

SHELL *COMPRESSED AIR* LUBRICANTS

COMPRESSA OIL
FOR AIR COMPRESSORS

CLAVA OIL
FOR AIR TOOLS

THINKING OF BUYING A NEW AIR COMPRESSOR?

If so, don't buy merely an anti-frictionized compressor; buy a *Timken Bearing Equipped* compressor and thus be sure of getting anti-friction advantages *in full.*

With Timken Tapered Roller Bearings on your compressor crank shafts you will get not only smooth, frictionless operation, but greater endurance and economy as well; for Timken Bearings prevent crank shaft wear, preserve crank shaft alignment and protect it against radial, thrust and combined loads.

Shown in the photograph is an Ingersoll-Rand IK-315 Mobil-Air Compressor equipped with Timken Bearings, supplying power to an Ingersoll-Rand FM-2 Wagon Drill —also equipped with Timken Bearings—and Ingersoll-Rand JB-5 Jackhamer, all working on the construction of a reservoir in New England. The Timken Roller Bearing Company, Canton 6, Ohio.

5TH WAR LOAN

"Join the Fight"

TIMKEN

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TAPERED ROLLER BEARINGS